# SCIENTIFIC AMERICAN

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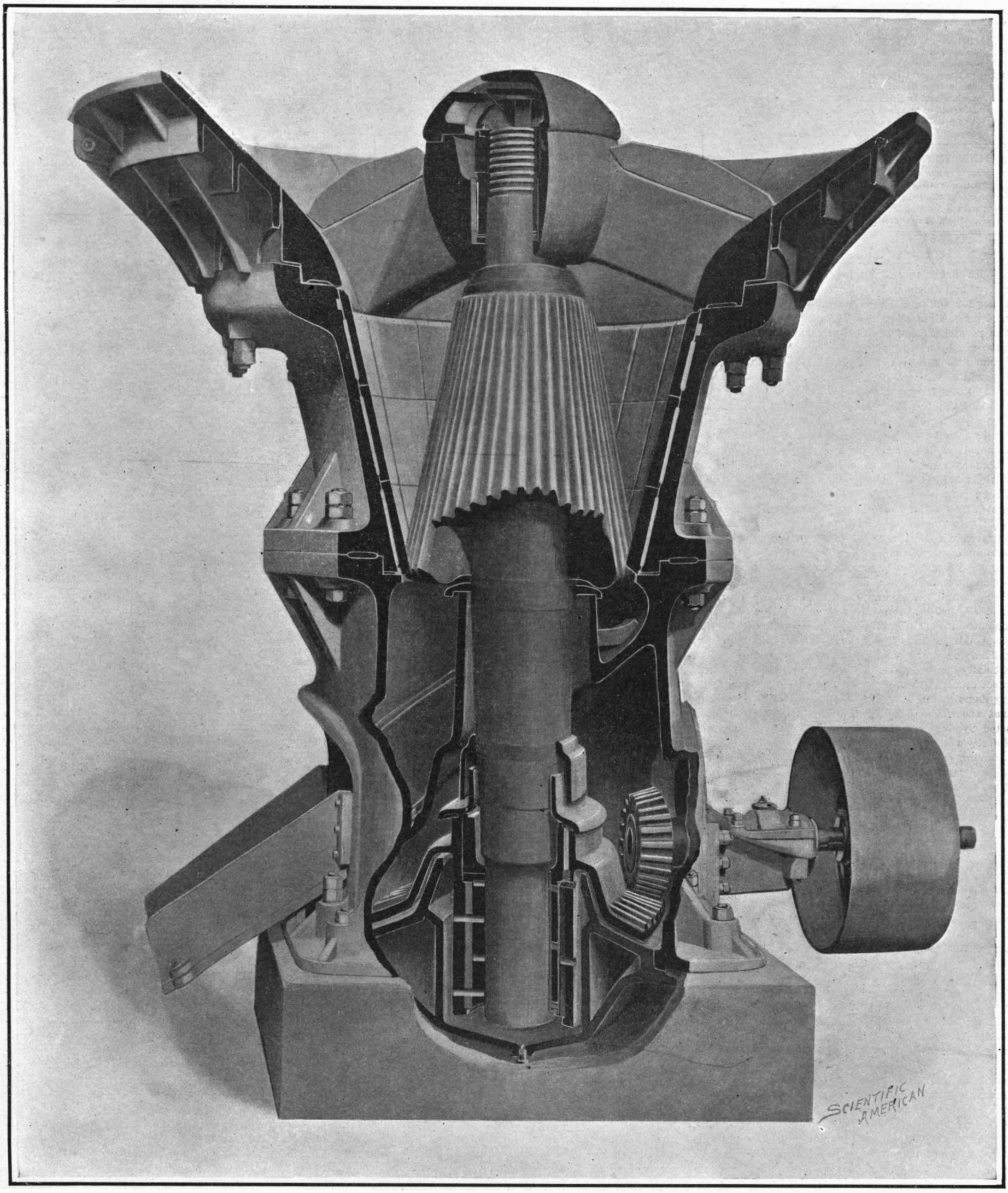
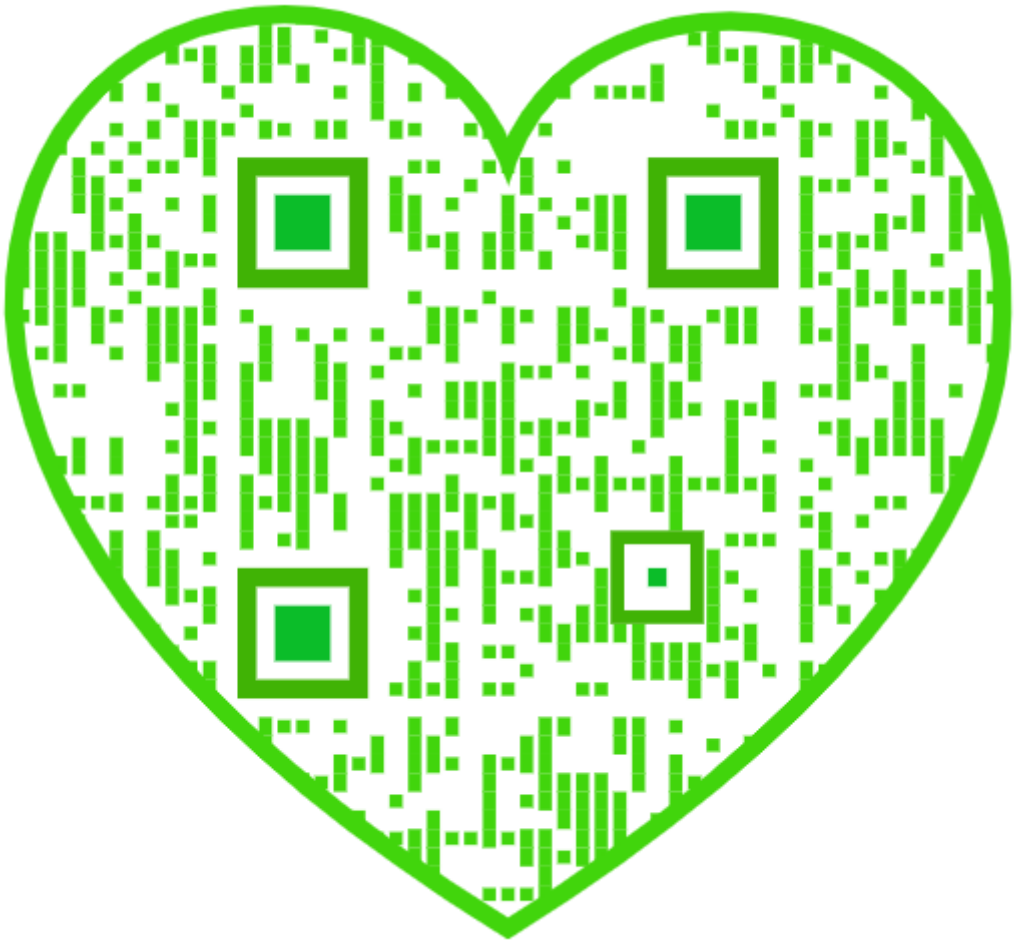



**This huge crusher will take rocks as large as 3 x 5 x 10 feet, reducing them to 6-inch size at the rate of 800 tons per hour. Diameter of hopper, 20 feet; height of machine, 18 feet 11 inches; total weight, 425,000 pounds.**

**A MAMMOTH GYRATORY STONE CRUSHER.**—[See page 314.]



# SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, NOVEMBER 7, 1908.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.


## A PRECAUTION AGAINST WATER FAMINE.

With drinking water retailing at thirteen cents a gallon and farmers driving their cattle six and eight miles for water, the inhabitants of the Hudson valley, at least, will realize that those who have spoken of the possibilities of a water famine in New York city have not been crying "wolf" when there was no wolf. Thanks to the fact that the extraordinary rains of last winter filled all the reservoirs of the Croton watershed to overflowing, there was no immediate danger, in spite of the recent extraordinary drought, of a scarcity of water in this city. But had the past season chanced to be as dry as the present one, conditions would have been very different.

The average daily consumption of water in New York is 325,000,000 gallons daily, and it is increasing at the rate of about 15,000,000 each year. The average daily flow of the Croton River, from which New York gets its water, during the forty years in which observations have been taken, is 402,330,000 gallons; but during that time, in six different years, the average daily flow has been less than the present daily consumption. In 1872 it was 260 million gallons; in 1880, 205 million gallons; in 1883, 230 million gallons; in 1885, 295 million gallons; and about the same amount in 1892. Another dry year occurred in 1895, when the average daily flow was only 263 million gallons; or over 60 million gallons less than the present daily consumption. These dry years are, of course, offset by correspondingly wet years, and it is by building dams in the watershed and impounding the water, that the deficiencies of the dry years are compensated by drawing on the water thus stored to meet the city's demands.

During the past forty years the city has built successive dams on the various branches of the Croton River to meet the growing demand of New York for a larger reserve, until at the present time there are in the Croton watershed nine separate dams, with one under construction, which, together, will have a total storage capacity of 104 billion gallons. During the past winter, from the 6th of November to the 15th of March, all the reservoirs on the watershed were full and overflowing, and there was an overflow over the new Croton dam (located about 2 miles from the point where the Croton River empties into the Hudson), which continued uninterruptedly for eight months, during which time over 80 billion gallons of water ran to waste.

With a view to increasing the storage capacity in the watershed, the engineers of the Aqueduct Commission recently made a careful survey of the one remaining section of the watershed which has not as yet been fully developed and where a large amount of additional storage can be secured at a relatively low cost for the dam and accessory works. The site on the east branch of the Croton River above the present Sodom or East Branch reservoir, selected for the new dam, is decidedly favorable for cheap storage, the bottom being broad and flat, the sides steep and abrupt, and the closure of the valley requiring the construction of a comparatively short, low, earthen dam, which could be built in two seasons of work. The construction of this dam at a cost of about $3,250,000, would provide for an additional storage of 20 billion gallons of water.

Now the question may be asked, Why should an additional dam be built in the Croton watershed when we have under construction the great Catskill project which is designed to bring ultimately an additional daily supply of 500 million gallons into the city? The answer is that the most sanguine estimates, based upon the present rate of progress, place the period which will be required to render the new water supply available at about six years; while, judging from the obstacles which have been encountered in the survey for the great siphon below the Hudson River, the time may be easily two or three years more than that. Now taking the average daily increase in consumption during the next 7 years as 17 million gallons (a conservative estimate in view of the rapid growth of New York city), it will be seen that, before the Catskill supply is available, the average daily consumption will be 43 million gallons greater than the average daily flow of the Croton River during the past forty years; and it might well happen that two successive dry seasons, such as have occurred in the past, might find the city with empty reservoirs and a daily river flow that was less than the daily consumption.

As to the probability of the proposed dam becoming filled in any particular year, it can be said that the records of the past forty years, except during the time that was required for filling the new Croton reservoir on its completion, show that a very large amount of water ran to waste, every year, past the Croton dam, a quantity which has varied from 35 billion gallons to more than 200 billion gallons.

For the above reasons it seems to us that the securing of an additional supply of 20 billion gallons for the relatively low expenditure of $3,250,000 is a proposition which should commend itself to the authorities.

## CARNEGIE MERIDIAN ASTROMETRY EXPEDITION.

Astronomers are very much interested in the meridian astrometry expedition, which has been sent out by the Carnegie Institution in charge of Prof. Boss of the Dudley Observatory.

The party sailed for Buenos Ayres a few days ago, where a temporary observatory is to be built in the Argentine Republic, at San Luis, on the edge of the Andean plateau. This locality has been selected on account of its clear, calm nights and the purity of its atmosphere.

This gigantic task of star measurement in the science of exact meridian astrometry consists of a series of observations of about 25,000 stars that have been frequently observed with precision in the southern heavens.

The Carnegie Institution hopes to reach an accuracy which has long been the problem of fundamental work in astronomy, that of making reciprocal observations on the same stars with the same instruments alternately used in two hemispheres. About 1,688 stars have already been catalogued, all from the north to the south pole of the heavens, and this work has resulted in interesting conclusions in reference to star streams, the solar motion in space, and other stellar problems.

The progressive conception of astronomical work by the Carnegie Institution is cognizant of the imperative need of further observations upon the stars of the far southern constellations.

There are but few observatories in the southern hemisphere, therefore the astronomers of that hemisphere are in need of reinforcement.

In connection with this expedition it might be recalled that the astronomical world is in debt to an American astronomer, in a great measure, for all that is known of the southern heavens; for there stands in the Argentine Republic the Cordoba Observatory, a splendid national institution, due to the scientific genius and energy of Dr. Benjamin A. Gould, an eminent American astronomer, who resided there for fourteen years and made a vast number of valuable observations.

Prof. Lewis Boss, who is in charge of this great astronomical work, is splendidly equipped for the work, and the world will watch with eager interest the result of his five years' observation of southern stars.

## DETECTION OF CARBON MONOXIDE IN THE AIR.

Poisoning by carbon monoxide is of frequent occurrence, for this gas is extremely poisonous and it is generated in many ways. The danger of poisoning is increased by the fact that the gas is colorless, odorless, and tasteless. Its toxic power is sixty times that of carbon dioxide. It is absorbed in appreciable quantities by the blood from an atmosphere containing it in the proportion of one part in 5,000. When air containing one part of carbon monoxide in 2,000 is inhaled, the blood absorbs as much carbon monoxide as oxygen, and death ensues.

The presence of carbon monoxide in considerable proportions may be detected by drawing some of the suspected air, with an aspirator, through a solution of silver nitrate. If the air contains much carbon monoxide the liquid soon assumes a grayish tint, due to the reduction of the nitrate to the metallic form. This method is only qualitative and not very sensitive, but it is very convenient for discovering leaks in furnace pipes and flues and in ascertaining whether the latter have been sufficiently ventilated to be safely opened for cleaning.

MM. Lévy and Pécoul have devised a method and apparatus by which as small a proportion of carbon monoxide as one part in 100,000 can be detected, and very small quantities can be determined quantitatively by persons entirely inexperienced in chemical manipulations. This method is based on the power of carbon monoxide to decompose iodic acid, with the liberation of iodine, which is betrayed by its color.

The apparatus, which is arranged compactly in a wooden case, comprises an aspirating bottle of known capacity, a test tube containing chemically pure anhydrous iodic acid (iodic anhydride, $I_2O_5$) and a long air tube, part of which is immersed in a water bath heated to 144 deg. F. by a small spirit lamp. The air first traverses the heated coil, then bubbles through the iodic acid, to which it gives a red tint of intensity proportional to the quantity of carbon monoxide, and finally reaches and fills the aspirator. At the end of the operation the proportion of carbon monoxide in the air can be estimated by comparing the liquid in the test tube with a color scale, in which each tint corresponds to a definite proportion of carbon monoxide. Still greater precision can be obtained by using a scale of colored liquids in sealed glass tubes.

Iodic acid is so sensitive to the action of carbon monoxide that this method is not suitable for air containing more than one part of carbon monoxide in 10,000. If the proportion is greater than this the suspected air must be diluted with pure air, in definite or indefinite proportions, according as a quantitative or only a qualitative analysis is desired.

As a prolonged exposure to an atmosphere containing even one part of carbon monoxide in 20,000 is injurious to health, tests of this character should be frequently made in all establishments in which there is danger of contamination of the air with this poisonous gas, all leaks should be promptly discovered and repaired, pipes should be thoroughly ventilated before they are entered for cleaning, men should not be compelled to remain long at posts where the air is unavoidably contaminated, all conduits which may contain carbon monoxide should be painted red, and workmen should be strictly forbidden to remain in their vicinity except when actually at work there.

## THE FALLACY OF ARTIFICIAL FOOD.

In these days of concentrated foods prepared from natural sources—such as condensed and dried milk, concentrated albumen, beef extracts, etc., there seems to be a tendency to sacrifice the pleasures of the table to convenience, portability, and time saving; and the question might arise, Would it be possible for us to exist entirely on artificial food? According to Francis Marre, it appears to be improbable that this consummation, whether devoutly to be wished or not, will come into effect. The human stomach is not merely a chemical laboratory, but also a creature of habit, that calls for work. It demands a certain bulk of material, out of which the intestines can take the nourishing constituents, while rejecting the innutritious. As soon as the intestines are relieved of the necessity of seeking out the necessary and rejecting the unnecessary portions of food, the digestive function is suppressed. Further, certain bacteria must be introduced into the digestive tract, whose co-operation is absolutely necessary to proper assimilation of the food. Chemically-pure artificial foods would be free from all bacteria. The human system is accustomed to be nourished by various kinds of aliments, no one of which is alone sufficient to promote life. In order to imitate these constituents, the chemical foods would have to be prepared in an extraordinary degree of variety and complexity. Eating is not merely a matter of introducing into the system a certain weight of materials, which will develop a certain number of heat units. The reception and digestion of food must be accompanied by a certain degree of pleasure, in order to permit it to be properly assimilated. Experiments made with a dog show that the secretion of those stomachic juices which are necessary to the commencement of the digestive processes, ceases immediately, and remains absent during several hours, as soon as a feeling of displeasure is excited in the animal.

The twelve new torpedo boats under construction for the German navy are to be driven by steam turbines. According to Engineering, it is planned to try four different types of turbines. The three boats which the Vulcan yards near Stettin are constructing are to be equipped with turbines of the Curtis type. The four boats which the Schichau yards of Elbing and Danzig have undertaken to build, will have Melms and Pfenninger turbines. Of the five torpedo boats under construction at the Germania yards at Kiel, four are equipped with Parsons, and one with Zoelly turbines.

## ENGINEERING.

**The "Kaiserin Elizabeth"** has recently been completely modernized. Her old 9.4's have been replaced by 6-inch guns, and several of the other 6-inch mounted in different positions. The rig has also been changed.

**Rear Admiral Holiday,** Chief of the Bureau of Docks and Yards, recently spent three weeks in investigating the new naval base at Pearl Harbor in the Hawaiian Islands. He states that there are 5,000,000 cubic feet of coral and sand, which must be dredged out to provide the required depth. The estimated cost of the completed harbor, which is to be finished by 1912, is $5,000,000. Mare Island and Bremerton yards on the Pacific coast, are also to be greatly enlarged.

**The Hudson River** tunnels have now been in operation for sufficient time to enable detailed figures to be given as to their earning capacity. The present gross earnings per car mile are almost twice as great as those of the Subway and Manhattan Elevated lines, the Hudson tubes earning 40 cents per car mile as against 21½ cents and 21 cents, respectively, for the Subway and the Elevated roads. The higher rate is due to the shorter distance between termini of the tunnel lines.

**The thriving city of Seattle** is engaged in reducing the heavy grades which occur in certain sections of the city by a process of sluicing, which is giving good results. Both salt and fresh water are being used for the purpose, and the contractors, Lewis & Wiley, are using it to the extent of 25,000,000 gallons a day, one half of this being taken from the bay, and the other half being obtained by purchase from the city or directly from Lake Washington. To date, there has been sluiced into Elliott Bay the total of 1,800,000 cubic yards of material.

**The president** of the Fore River Shipbuilding Yard, Francis T. Bowles, lately chief constructor and a rear admiral of our navy, is to be congratulated on having created a new record for quick shipbuilding in this country. Our first American "Dreadnought," the "North Dakota," which will be launched November 10, will be about sixty per cent completed when she takes the water. It was plainly Mr. Bowles' agitation for the construction of warships in government navy yards that started the present era of the rapid construction of ships by private builders in this country.

**The rapidity** with which England builds her warships is shown in the remarkably short time occupied in the construction of each of the six "Dreadnoughts," which she will have afloat by next month, when the "Collingwood" has been launched. The average time of construction, from the time of laying the keel to the launch, was seven and one-third months. With this rate of building and the large number of government and private dockyards at her disposal, she could pretty well replace the wastage of war, as it occurred, with new ships, if she should ever be forced to a protracted struggle.

**Although** it is early as yet to compare the cost of operation of electric and steam locomotives, enough has transpired to indicate that the electric locomotives cost considerably less. It takes 30,000 miles of running to wear down the tires of an electric locomotive 1/32 of an inch, whereas that amount of wear will take place in from 8,000 to 9,000 miles on steam locomotives. It is not necessary to give the electric locomotive a roundhouse inspection at the end of every day's work. They are inspected at the end of every thousand-mile run, and the work can be done in about three and a half hours. According to J. P. Kelly, speaking before the Traveling Engineers' Convention, the roundhouse examination consists in blowing out the electrical apparatus with an air blast; examining the motors; cleaning the commutators, contactors, switches, and controllers; gaging the contact shoes, and oiling the journals. The inspection can be commenced at once, since there is no fire cleaning, coaling, or watering to be done.

**In the tests** conducted at the fuel testing plant at St. Louis, Mo., and Norfolk, Va., to determine the values of different kinds of fuel for use in the gas-producer, the United States Geological Survey obtained some interesting results with a bone coal which is found in West Virginia. Although the fuel was found to be of little value under the steam boiler, it gave good results in the gas-producer, where it developed a brake horse-power for each 1.65 pounds of coal consumed in the producer. The lumps of coal were 8 and 10 inches in diameter. Some consisted of a high-grade bituminous coal, others appeared to be simply lumps of a heavy and very hard rock. All of these lumps, except the largest, burn entirely through in the producer. There is no tendency to clinker or coke, and very little stoking is required. There was a high percentage of about forty-five per cent of ash. With proper crushing and suitable attention the deposits of this fuel will prove to be decidedly valuable for producer-gas plants.

## ELECTRICITY.

**The life** of a 4-inch trolley wheel averages between 8,000 and 10,000 miles, while a 5-inch wheel will run between 20,00 and 25,000 miles, as shown by extensive tests with trolley wheels in Baltimore. The results of these tests were reported by H. H. Adams before the Interurban Railway Engineering Association.

**A new postal transport system,** which will render the service independent of railways, is interesting the postal authorities of Milan, Italy. It is proposed to construct an underground tube for small electric trains consisting of an engine and two or three postal cars, which will run at over 90 miles per hour. The wheels would have leather tires and run on cement rails. The line would run between Milan and Genoa, a distance of about 100 miles.

**An automatic** grade-crossing gate has recently been installed on the Montreaux-Bernese Oberland electric railroad in Switzerland. At a certain distance from the grade crossing a parallel line close to the main trolley wire is connected with the power by means of the trolley bow. This energizes the motor which lowers the gate across the highway. At the same time an electric bell is sounded and a couple of electric lights are lighted as a warning that a car is approaching. The gates are lowered in about twenty seconds. After the car is passed they are raised by a counterweight.

**By photographing** the spectrum of an ordinary spark on a rapidly-moving photographic film, T. Royds, writing in Electrical Engineering, London, has been able to determine the constitution of the electric spark. He finds that at first there is an almost instantaneous luminosity, due to the initial air discharge, after which the light of the spark comes mainly from the metallic vapor produced. Streamers of luminous vapor appear at both the positive and the negative electrodes; and when the self-inductance of the spark is increased, several streamers start from the electrodes during a single oscillation.

**The rectifying effect** of an alternating-current arc has been studied by J. Sahulka, writing in the Elek. Zeit. He finds that ordinarily the lower carbon of the arc is positive, but that this depends upon the temperature of the electrode. The cooler carbon is always positive, so that by using carbons of different thickness, the thinner one, which would necessarily be hotter, would be negative. The author has used the arc for rectifying purposes by having one of the electrodes consist of a rotating carbon disk. The current in the external circuit would then flow from the stationary electrode to the relatively cooler rotating electrode. In this way he obtained a direct current of one-seventh the strength of the alternating current.

**To increase the resistance** of the tungsten filament, and thus permit the use of a shorter filament in the lamp, a new process of manufacture has been evolved, which consists of mixing thorium oxide with the tungsten. The tungsten and thorium oxide are combined in various proportions and mixed with thirty-five per cent of an alloy consisting of cadmium, bismuth, and mercury. This alloy is vaporized in the course of manufacture. It is claimed for the resulting filament that with the addition of twenty per cent of thorium oxide its resistance is increased fifty per cent. As much as fifty per cent of thorium oxide may be used, but a higher percentage renders the filament too brittle.

**It is found** that in an ordinary room, from which sunlight is excluded, the brightness of the daylight commonly runs as low as 1/10, or even 1/100 candle-power per square inch. The intrinsic brightness of nearly all artificial lights is much greater than this, which accounts for the injurious effects they produce on the eyes if located within the range of vision. In a paper read before the Illuminating Engineering Society of Philadelphia, J. E. Woodwell discussed this subject, arriving at the conclusion that the best illumination is a diffused light of from 2/10 to 1/10 candle-power per inch. Although ultra-violet light has heretofore been held accountable for strain and other injury of the eye, he points out that there is less ultra-violet light in the rays of various incandescent illuminants than in direct or even reflected sunlight.

**The success** of the electric system on the New Haven Railroad was discussed recently by an electrical engineer of that line. He states that train delays at the present time are less than those occurring during steam operation. The advantage of using locomotives consisting of two individual half units and operable individually, or as a pair, by single crew, has been demonstrated. Seventy-five per cent of the traffic is operated with half-unit locomotives. A pound of coal burned at the central station produces twice the drawbar pull of a pound of coal in the steam locomotive. But the greatest value of the electrification is that it increases traffic capacity, owing to the facility it offers of making rapid main-line and yard-train movements. In other words, the electrification permits a tremendous increase of traffic without an increase of track mileage.

## SCIENCE.

**Seeds of wild fruits** and vegetation growing in Central China are to be forwarded to Luther Burbank to see if he can cultivate them and produce luscious fruit and useful trees and foliage in places rarely penetrated by white people.

**Fossil Eggs Found in a Mine.**—Fossil eggs, some of them large as a man's head, which were recently found in the 2,000-foot tunnel at Copperreid, Nevada, have been pronounced genuine by Prof. Horace Chapman, of the University of Pennsylvania faculty. The eggs were found by blasting in the end of the tunnel. The adjoining strata indicated to the discoverers that the fossil eggs had been buried to a depth of about 7,000 feet. The specimens show that minerals have displaced the contents of the eggs.

**At the end of this year** (December 22-23) there will be a total eclipse of the sun, visible only in the southern hemisphere. Astronomers have been endeavoring to find a spot from which the eclipse can be observed. Bouget Island, situated in latitude 54 deg. 22 min. S. and longitude 3 deg. 1 min. W., has been suggested, but M. W. Downing, director of the British Nautical Almanac, points out the important fact that this island lies 10 minutes south of the southern limit of the zone of totality, so that only 0.988 of the sun's diameter will be eclipsed.

**A research party** from the American Museum of Natural History, headed by Barnum Brown, has discovered part of the skeleton of a Tyrannosaurus Rex, a prehistoric animal, in the Bad Lands several miles south of Glasgow, Mon. The fossil, which is 40 feet long and 22 feet high, has a perfect skull, an entire set of ribs, back bone, and hip girdle and practically supplements the specimen discovered in the same section in 1902. The first fossil had good hind limbs but incomplete back bone. The museum will now be enabled to mount a complete animal.

**Balloonists** and mountain-climbers have long known that the temperature of the air falls as the altitude increases. It has recently been discovered that this decrease in temperature has its limits. "Sounding" balloons, freighted with automatic recording instruments, have been sent to heights far exceeding those which any balloonist can hope to reach. The records obtained show that at a height of about eight miles the thermometer ceases to fall, and may even rise. The distinguished French meteorologist Tisserand de Bort claims also to have discovered that at a certain level, the air above the poles is warmer than that above the equator, an anomaly which must be more fully demonstrated than is now possible, before it can be accepted.

**It has long** been known that sea water contains gold in solution, but in quantities so small that all attempts to extract it have proven unremunerative. Luther Wagoner has recently revived the hopes of the gold seekers by demonstrating that the quantity of gold varies greatly in different parts of the ocean, the ratio between the extremes being 1 to 30, and that the richer specimens of sea water may repay working for gold. In the first place, Wagoner finds that both gold and silver are more abundant in sea water taken from great depths than in the shallow waters near the shore. The following table shows, approximately, the number of grammes of gold and of silver that he finds in a cubic yard of deep-sea water from various localities:

| Locality. | Gold. | Silver. |
|---|---|---|
| East of Georges Bank..... | 3.9 | 23.1 |
| South of Georges Bank..... | 1.8 | 4.4 |
| Delaware Bay..... | 1.7 | 11.9 |

It would be difficult and costly to bring these waters to land, but possibly floating extracting establishments could be used.

**The volcano of Kilauea** is exhibiting phenomena never before known in the eighty years during which it has been closely observed. The activity in the central pit of the crater is of an explosive and spasmodic type never before noted there. The molten lava rises from the central pit from 10 to 400 feet within a few hours, and then as suddenly or more suddenly drops again, to rise and fall in the same way—unprecedented so far as this volcano is concerned. When it is considered that the area of this central pit is from 40 to 50 acres, the amount of matter that rises in it and then falls and rises again—squeezed out of it as it were, to be sucked back again—is enormous. The only hypothesis so far suggested for this unusual action is that in the movements that have been going on within the earth's crust at that point, a great cavity has formed like a Titan's trap, which gradually fills up with gases, which force the molten lava up into the pit until the gases accumulate to such an extent as to fill the trap and escape, allowing the lava to flow back into the trap. The earthquake of September 20, which was at first believed to have emanated from Mauna Loa, is now thought to have come from Kilauea. It has created a line of fissures extending for miles from Kilauea—first southeast and then northeast, through the sparsely settled districts of Puna.

**THE FOURTH VANDERBILT CUP AUTOMOBILE RACE.**

As mentioned in our last issue, the fourth automobile race for the Vanderbilt cup was run off upon a triangular course on Long Island on the 24th ultimo. The course this year was much better than before, owing to the fact that nearly half of it consisted of a fine smooth roadway of concrete, the turns of which were slightly banked and the grade crossings abolished. The grand stand was located about halfway between each end of the parkway. The cars traveled east from the grand stand to the end of this parkway, thence west across the island to Jericho. From this point they followed the Jericho turnpike along a fairly straight road to Westbury, and from Westbury the course led south to the other end of the parkway. Despite the fact that it was especially prepared for fast-traveling automobiles, the surface of this parkway was rather wavy, and produced a constant jumping of the machines when they attempted to make high speed. The fastest speed was probably made upon the Jericho turnpike, where some of the drivers believed their machines traveled 95 miles an hour.

Of the nineteen machines entered in the race, but seventeen started. A Brasier car broke its steering gear while being driven to the starting line, and a B. L. M. was not completed in time to compete. The American cars were headed by two 120-horse-power Locomobile racers, and two 115-horse-power Thomas racers that competed in the last Vanderbilt race, two years ago. The third Thomas machine, of 80 horse-power, is the same car that was driven by Strang in the Grand Prix race in France last summer. Two Matheson machines of 60 and 85 horse-power and two Knox cars of 40 and 50 horse-power completed the list of 4-cylinder American machines. To these should be added Acme and Chadwick 6-cylinder machines of 60 horse-power each.

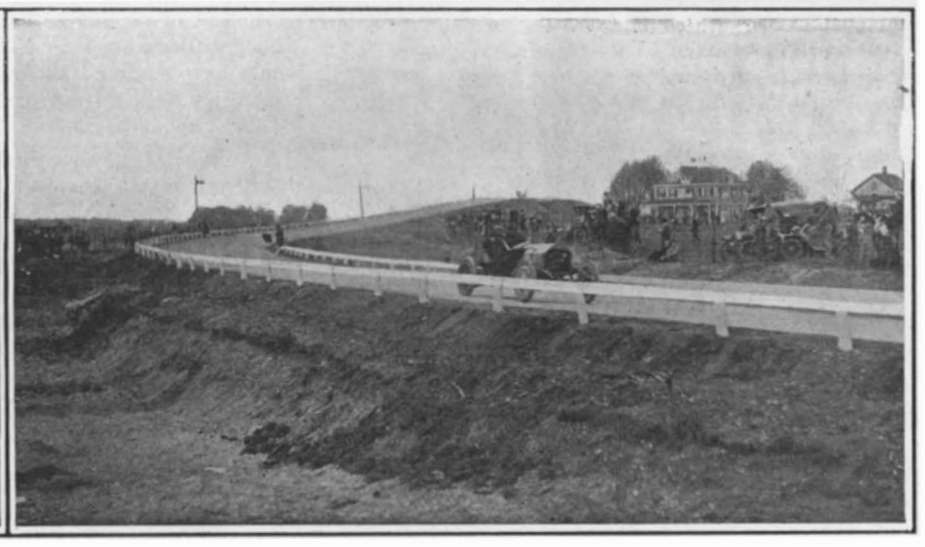
The foreign cars consisted of three 120-horse-power Mercedes machines; a 120-horse-power Hotchkiss, a 115-horse-power Renault, and a 60-horse-power Isotta. The Hotchkiss and Renault cars were high-powered racers which had appeared in the previous Vanderbilt cup race, while the Isotta has won several of the big races during the past summer.

The race was started promptly at 6.30 A. M. The oiled roads, forming more than half of the course, were very slippery, and made necessary the use of steel-studded, non-skidding tires. The first car to start was a Locomobile racer. This was followed by the smaller Knox stock car, while car No. 3 was a 120-horse-power Mercedes, driven by Stricker, who had had an accident a week before, but had not been seriously injured. All of the seventeen cars started in good shape, and succeeded in completing the first lap without difficulty, with the exception of Foxhall Keene, who had trouble with his Mercedes. Robertson was obliged to stop his No. 16 Locomobile racer in front of the grand stand, to refill the radiator at the end of the first lap. He completed this lap of 23.46 miles in 20 minutes and 54 seconds, and was, consequently, in the lead. The Isotta car made its first round in 21:52, and a Chadwick in 21:53. At the end of the second round the Locomobile No. 16 still led, but the Chadwick and Isotta had changed places. The end of the third round found them in the same position. The fourth round saw the Chadwick in the lead, the Isotta second, the Mercedes No. 3 third, and the Locomobile No. 16 fourth. In the fifth round Mercedes No. 3, driven by Stricker, and the Isotta car changed places; while at the end of the sixth round the Chadwick was first, the Locomobile No. 16 second, the Isotta third, and the Mercedes No. 3 fourth. During the seventh round the Locomobile moved ahead to first place and the Isotta to second place, while Mercedes No. 3 was third. The cars ran in this order until the end of the tenth round, when Mercedes No. 3 dropped out and Mercedes No. 5 attained third place. In the eleventh or final round Locomobile No. 1 forged ahead of Mercedes No. 5.

The reasons for the changes in place of the leading cars, as well as some of the troubles of the others, are given herewith. During the first round, Mercedes No. 18, which was owned and driven by Foxhall Keene, had a flare-up at the carbureter. Mr. Keene managed to extinguish the flames and continue, but this mishap had cost him a

**Filling the fuel tank of the Isotta in front of the grand stand.**

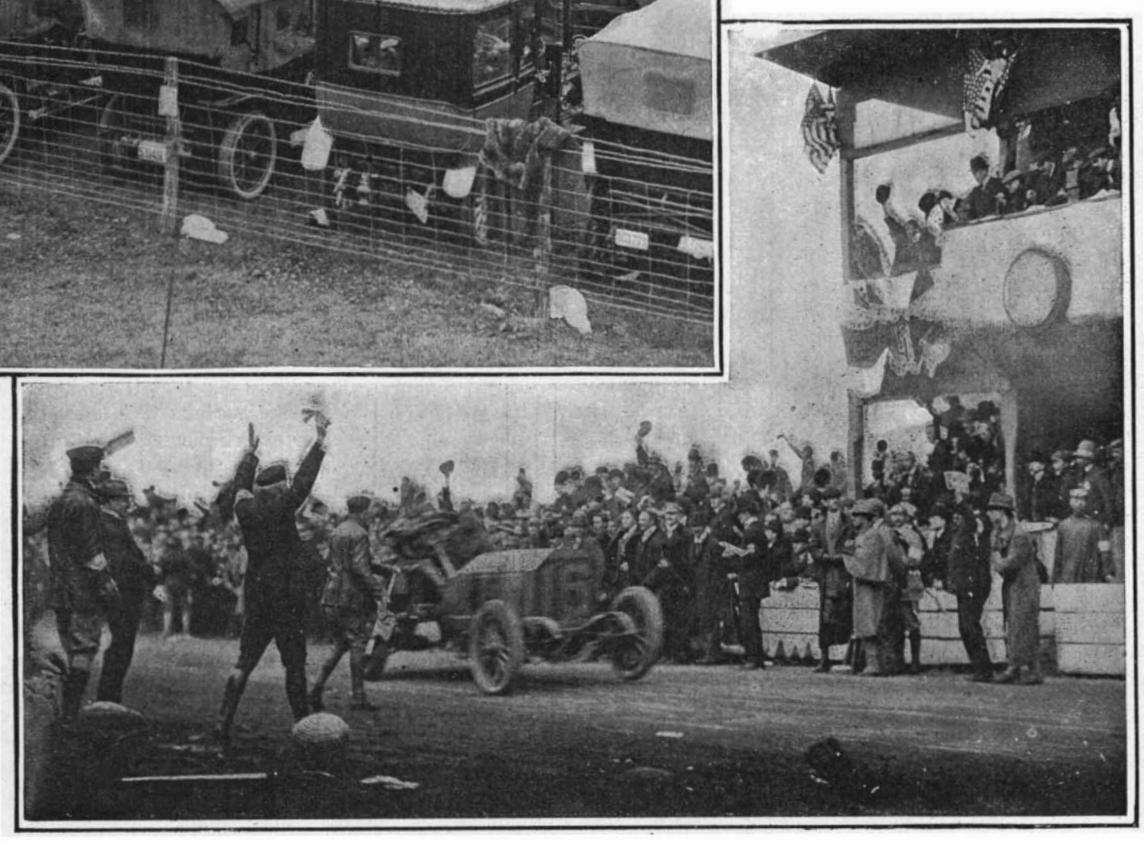
This 60-horse-power Italian machine was beaten by only 1 minute 48½ seconds.



**The Long Island motor parkway, which formed half the course.**

The view shows the descent from one of the bridges, and the sharp, slightly banked curve before the grand stand is reached.

**The crowd of cars at the grand stand.**

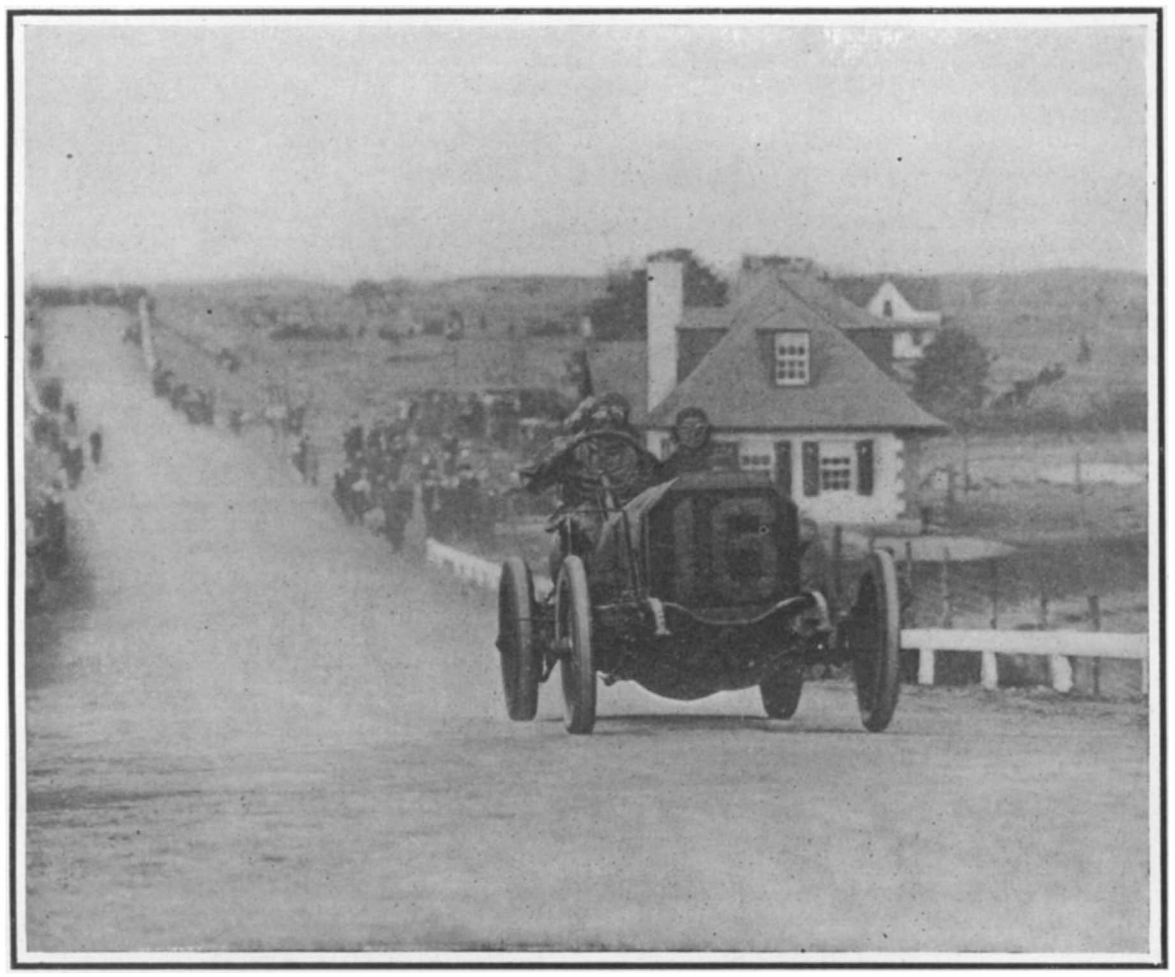


**The winning 120-horse-power Locomobile finishing.**

**THE FOURTH VANDERBILT CUP RACE.**

full half hour. As Robertson lost nearly two minutes refilling his radiator at the end of his first lap, the time of his second lap was lengthened to 22:13. Notwithstanding this he was still leading, though by 15 seconds only. The Chadwick made its second lap in 21:29, and consequently was 4 seconds ahead of the Isotta. Stricker's No. 3 Mercedes had tied the Chadwick (the times of both being 43:22 for the first two rounds) after a round in 20:57, and Locomobile No. 1 a badly-fitting dismountable rim, so that at the end of the eighth round it was only running sixth.

The same order was maintained during the eighth and ninth rounds, but in the tenth Stricker's Mercedes was put out of the running by a broken fan blade hitting the radiator, breaking it beyond repair. Mr. Vanderbilt's Mercedes, No. 5 (driven by Luttgen), thereupon took third place. At the end of the tenth round the Isotta was 4 minutes and 10 seconds behind the



**The winning Locomobile racer shooting over a bridge on the motor parkway.**

was fifth after having completed its second round in precisely the same time as its mate, viz., 22:13. No. 12 Thomas racer was sixth. Its first and fastest round had been made in 22:04. The mate of this machine, No. 19, had trouble with its gears in the second round and dropped out. No. 15 Matheson, the 85-horse-power car driven by Chevrolet, cracked a cylinder and was obliged to quit.

In the third round Robertson made the fastest time, as he completed the circuit in 20:17, which was at the rate of 69.39 miles an hour. The 6-cylinder Chadwick was 1 minute and 25 seconds behind the Locomobile, and the Isotta 26 seconds behind the Chadwick. But 1 minute and 4 seconds separated the Isotta and Mercedes No. 3, while Locomobile No. 1 and Thomas No. 12 were still fifth and sixth respectively. The 6-cylinder Acme and the Hotchkiss racer dropped out in this round with a broken two-to-one gear and a broken clutch respectively.

The fourth round was a notable one, as all the leading cars made fast time. Locomobile No. 16 lost three minutes at the grandstand changing a tire and taking on some extra shoes, and as a result of this it dropped to fourth place. The Chadwick made its fastest round in 21:21 and was in the lead. The Isotta was 1 minute 9 seconds behind the Chadwick and 1 minute 23 seconds ahead of Mercedes No. 3. The Renault racer, driven by Strang, dropped out in this round with a burnt-out clutch. The second Matheson caught fire from a leaky carbureter placed too near the exhaust, and added one more to the eliminated cars.

The fifth round was another fast one, the only change being that Stricker's Mercedes No. 3 passed the Isotta and was leading it by but 27 seconds, while the Chadwick was 2 minutes and 34 seconds in the lead. Locomobile No. 16 was 3 minutes and 51 seconds behind the Chadwick. Foxhall Keene's Mercedes again caught fire, and this time it was out of the race.

In the sixth lap Robertson made the circuit in 20½ minutes, which brought him from fourth to second place, and in fact almost to first, for he was but 13 seconds behind the Chadwick.

Magneto trouble in the seventh lap delayed the Chadwick for half an hour and put it hopelessly behind. This machine was the only car in the race equipped with two separate magnetos, but unfortunately the breakdown that occurred affected both, and still another had to be fitted. Robertson made this lap in 20:36, and Lytle, with the Isotta, in 22:05. The former was leading by 2 minutes and 9 seconds, and the latter was 4 minutes and 56 seconds ahead of the Mercedes. The Thomas No. 12 was fourth, but at the end of the round it was delayed 20 minutes changing Locomobile and 22 minutes and 44 seconds in advance of. Mercedes No. 5. The Thomas racer was 4 minutes and 41 seconds behind the German car and the second Locomobile (No. 1) but 56 seconds back of the Thomas.

As the Isotta started 10 minutes before the Locomobile, it naturally finished first. Its eleventh and last lap was made in 21 minutes 50 2/5 seconds. Shortly before the Isotta finished, word was received at the grand stand that the Locomobile was off the road changing a tire. There was great excitement until it was learned, some two minutes later, that Robertson was on his way again. Not until he had less than two minutes in which to finish did his car appear upon the high bridge over half a mile away, and dash down the incline and around the curve (see one of the photographs) to the grand stand. "Time 4 hours, 48 1/5 seconds," yelled the announcer, and it was known that one of the fastest and staunchest of American machines had won the Vanderbilt Cup at last. Robertson had defeated Lytle and his Italian Isotta car by but 1 minute 48 1/5 seconds, however, in the second long-distance race on the same course, in which the latter machine had averaged about 64 miles an hour; for in the sweepstakes race on October 10 the Isotta made an average speed of 64.2 miles an hour, while in the Vanderbilt Cup race it made an average of 63.7, the average speed of the winner, which had about double the horse-power, being 64.39. The chief cause of the more powerful machine failing to make a higher average is given as being the unevenness of surface of the cement parkway and the fact that there were many curves in it. In the 1906 race (which was won by a Darracq machine with an average speed of 61.43 miles an hour) Tracy made the fastest round with one of the two Locomobiles that competed this year, his average speed on that occasion being 67.66 miles an hour. The record fastest lap was made by Lancia on a Fiat in the 1905 race. His average speed for the lap was 72.88 miles an hour.

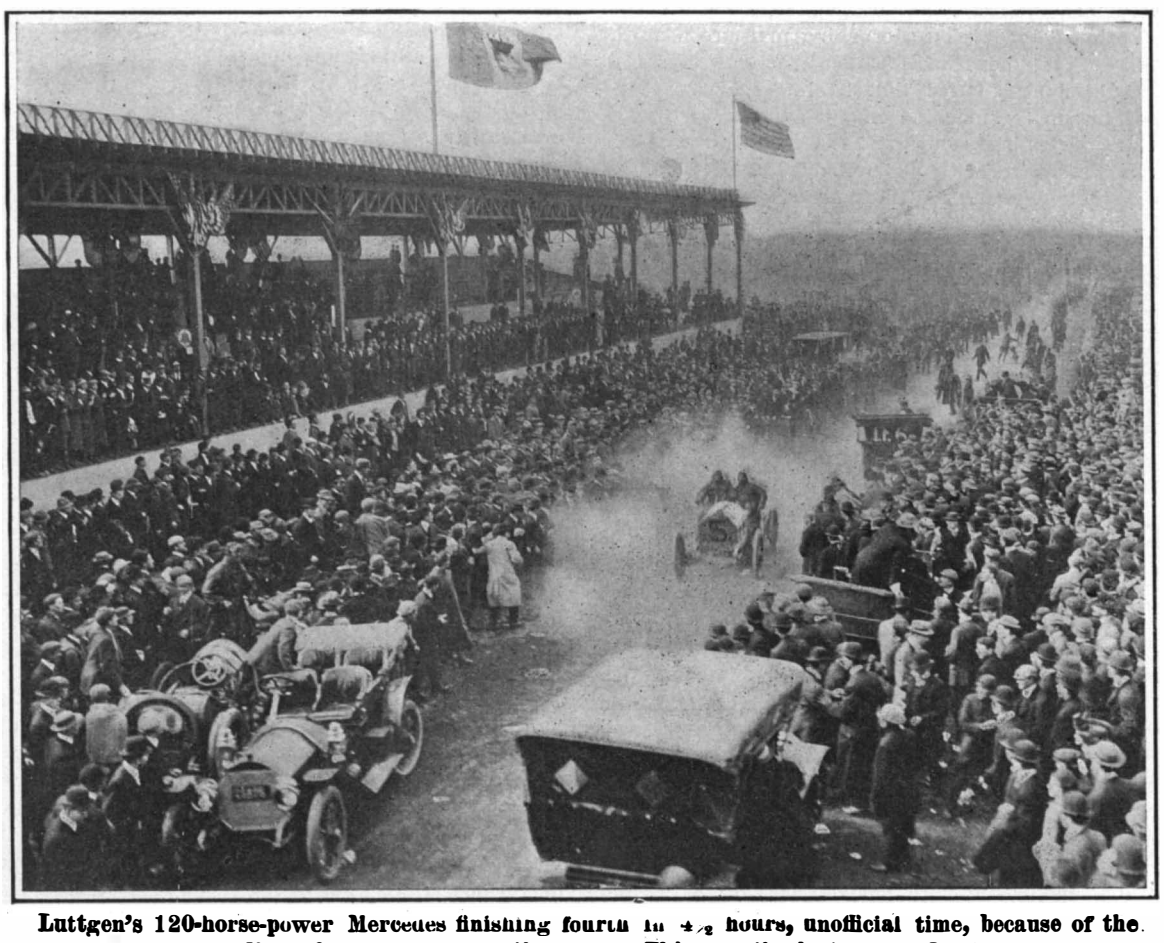
### Varnish Made with Carbon Tetrachloride.

Carbon tetrachloride is an excellent solvent for many resins, particularly such as are dissolved by benzine and mixed nitric and hydrochloric acids but are nearly or quite insoluble in alcohol. A very superior varnish is made by dissolving gum dammar in carbon tetrachloride heated to 120 deg. F. This varnish is easily applied and gives a tough, transparent coating which wears better than dammar varnish made with turpentine.

Some resins of the copal class, which dissolve with difficulty in turpentine and very slowly in boiled linseed oil, dissolve readily in hot carbon tetrachloride.

Carbon tetrachloride also possesses the property of completing the dissolving action of alcohol on many resins, so that these dissolve quickly and entirely in alcohol mixed with from 10 to 20 per cent of carbon tetrachloride. Gum lac, sandarac, and some other resins, for example, dissolve but slightly in commercial denatured alcohol of a strength of 90 degrees, owing to the presence of water, but they dissolve completely on the addition of 10 or 20 per cent of carbon tetrachloride.

Mr. John Brown, F.R.S., of Belfast, made a short communication on "The Dry Daniell Pile," to the recent meeting of the British Association, which he described at the Cape meeting in 1905, and the great constancy of which he had since tested. The pile was built up of sheets of copper and zinc, coated on one side with sheets of twilled cotton fabric, wet with a hot 10 per cent solution of sulphate of copper or of zinc. Pairs of these electrodes, separated by layers of plain blotting paper, were piled upon one another and compressed by a screw. The pile was made by Mr. John Finnegan, of Belfast, and its superior constancy, maintained for years, recommended it for electrometer testing.



**Luttgen's 120-horse-power Mercedes finishing fourth in 4½ hours, unofficial time, because of the crowding of spectators upon the track. This was the last car to finish.**

**THE FOURTH VANDERBILT CUP RACE.**

### A MAMMOTH GYRATORY STONE CRUSHER.

On the front page of this issue we show a huge stone crusher, which is said to be the largest in the world. It is designed to take rocks as large as 3x5x10 feet, and crush them to 6-inch size at the rate of 800 tons per hour. The machine is in operation at a 4,000-barrel cement plant in South Pittsburg, Tenn. The rock is exceedingly hard and tough limestone, which is brought to the crusher in cars carrying 7,000 pounds. The loaded cars run down two tracks by gravity, and are automatically dumped directly into the hopper of the crusher by means of tipples. The machine stands 18 feet 11 inches high, and the mouth of the hopper is 20 feet in diameter with fairly steep sides, so as to facilitate feeding the stone from all sides by gravity.

The crusher belongs to the "suspended" type of machine, that is, the gyratory shaft on which the head is mounted is suspended from a spider at the upper end of the machine. Our illustration shows the crusher partly broken away, in order to reveal the arrangement of the interior mechanism. The massive spider at the upper end of the machine is formed with but two arms, so as not to obstruct the hopper. The openings at each side of the spider arms are 36 inches wide and 138 inches long, so that rock of the dimensions specified above can slide in without lodging against the spider arms. The shaft is supported in the hub of the spider in such a manner that it may oscillate slightly. The lower end of the shaft is formed with an eccentric bushing which engages an eccentric ring. The latter carries a bevel gear, which meshes with a bevel pinion on the driving shaft. As the driving shaft is rotated, the eccentric serves to impart a gyratory motion to the shaft. The crushing head, which is supported on this shaft, is conical in form with a corrugated surface, as indicated. The head operates in an inverted conical shell faced with 54 plates of steel, arranged in three rings. These plates are technically known as "concaves." The rock slides through the hopper and lodges between the crushing head and the concaves. The gyratory motion of the head produces a powerful crushing motion, which breaks up the rock, and the latter when reduced to proper fineness drops between the crushing head and the concaves into the lower shell of the machine, where it is guided by an inclined diaphragm to the discharge spout. The rock may be crushed to a smaller size by providing the lower tier of concaves with corrugated surfaces. The interlocking corrugations tend to break up flat pieces which would ordinarily slip through. Further regulation may be made by adjusting the conical head upward. This may be done by means of a nut, which is threaded to the upper end of the vertical shaft and rests on the bearing sleeve. The eccentric of the machine operates in a reservoir of oil, so as to reduce friction and wear of the parts to a minimum.

The top shell of this crusher was made in two pieces, because its size exceeds the limits of railroad transportation. Each half with its concaves weighs 57,000 pounds. The lower shell is a single casting and weighs 73,000 pounds, while the bottom plate, with the bushing gear and eccentric, weighs 38,000 pounds. The weight of the entire machine is 425,000 pounds. The crusher was designed to develop a crushing pressure near the bottom of the head of 1,500,000 pounds. Tests at South Pittsburg showed that 29 horse-power are required to run the machine empty, and the load when crushing varies between 56 and 153 horse-power. Granites and trap rock would probably take twice this power when reducing to 6-inch size. Manganese steel concaves and a self-tightening manganese steel mantle for the crusher head would be used to adapt the machine to crush granite, quartz, trap rock, and hard abrasive limestones. We are indebted to the Power and Mining Machinery Company, of Milwaukee, Wis., for our information on this machine.

### Relation of Government Fuel Investigation to the Solution of the Smoke Problem.

Statistics collected by the government indicate that the nation has consumed about seven billion tons of coal up to the present time. Last year the consumption was more than four hundred million tons. During the past ten years, nearly as much coal was used as had been used during the preceding century. This increase in the use of coal during the past century has been so great, that it is concluded that if the consumption continues to increase at the same rate, the coal fields of this country will be exhausted before the end of the next century. However, if by some means the increase in the use of coal can be checked, and the output of the mines kept down to the present figures, there will be no occasion to worry about the coal supply. But the increased demand for coal will probably continue, and we may reasonably look for a gradual rise in the price of coal as it becomes more difficult to mine it. Only the best and most profitable seams are being mined at the present time, the inferior coal being left in the ground. As used at present for heat, light, and power, the losses are so great that, of the total heating value of the coal, less than five per cent is converted into useful work in the ordinary manufacturing plant, and even some of the largest and best power plants are able to utilize only about ten per cent of the energy in the coal. In railroad operation only from three to five per cent of the coal value is realized for pulling the train. It is estimated that only one-seventh of one per cent of the fuel value is actually converted into light in an incandescent lamp. Nearly two million horse-power in the form of gas is allowed to escape from the blast furnaces of the country. This condition is rapidly being changed by the installation of gas engines to develop the power. There is also a great fuel waste in the manufacture of coke, besides the loss of many valuable by-products. It is estimated that these losses amount to fifty million dollars annually.

### A Problem for Inventors to Solve.

The great success that has attended the operation of high-pressure fire systems which are in use in New York and Philadelphia, and are soon to be installed in San Francisco and other large American cities, is marred by one important shortcoming, which furnishes an interesting problem to inventors. This is a suitable reducing valve for controlling the nozzle pressure on any single line of hose, so that the stream may be held and directed by one or two firemen unaided by any mechanical contrivance—a pressure of 50 pounds at the nozzle being the limit for such work. As it is the tendency to remove the fire engines as fast as the high-pressure equipment is provided (in fact, in the new system for the built-up districts of San Francisco, it is proposed to do without fire engines entirely), this need is really quite pressing. While the high pressure will deal effectively with a large fire or conflagration, for a small, ordinary fire it must be handled most carefully in order to prevent damage by water. This latter item may be considerable; and there is a tendency upon the part of insurance companies in writing policies for a high-pressure district to increase the amount on the building, but to decrease that on the contents, on account of the water damage. Now in a high-pressure system, on an order of the fire chief or commanding officer at a fire, the pumps are started, and a certain pressure at the pumps is maintained by an automatic regulating valve at any point between say 100 and 300 pounds, and this pressure with the slight loss due to friction is maintained throughout the distribution system. Hydrants are placed on the mains at intervals, and each hydrant has four outlets to which lines of hose may be attached, each outlet being controlled by an independent valve. It is evident that even at a fairly large fire the same pressure and volume of water is not required from every line of hose, while at a small fire a small stream well and quickly directed will extinguish the blaze most effectively, so that the obvious place for regulating the pressure, so as to get the same flexibility and adaptability possessed by the fire engine, is at the hydrant, where some portable form of reducing valve, that can be readily carried on the hose wagon and speedily attached, is demanded. The essential features of such a valve as outlined by Capt. Greely S. Curtis, an independent consulting fire engineer, in a recent report on the New York Fire Department, are that it must allow an ample and unobstructed flow of water when desired, that it should maintain any desired pressure on the hose, that it should afford immediate relief on shutting off the valve, and limit the pressure in the line to 40 or 50 pounds when the flow is stopped at the nozzle, that it should possess a double pressure gage showing the pressure both on the hydrant and the line sides of the valve, and finally that it should be durable. Not only is this an engineer's opinion, but it is that of the practical firemen now working with the high pressure. While a number of arrangements have been proposed, the inventor who produces a satisfactory and practical device to meet these conditions will without doubt earn a substantial reward.

### Distributing Cold Through Pipes.

The first international congress on refrigeration has just met in Paris. Its object is to awaken interest in the industrial and domestic applications of refrigeration. Artificial refrigeration originated in France but it has reached its greatest development in America. Cold is actually distributed to private houses in Boston, New York, St. Louis, Atlantic City, Baltimore, Norfolk, Los Angeles, Denver, and Kansas City, through systems of pipes which vary in length from 1 to 18 miles. The financial results show a still greater variance. The business is very profitable in some places and unremunerative in others. The Denver company, for example, has been forced to suspend operations.

In general it has been found advantageous to concentrate the production of cold in large establishments and to employ the ammonia process. There are two methods of distribution: by chilled brine and by liquefied ammonia, which is allowed to expand at the place where the refrigeration is desired. The latter method is preferred, and is used exclusively in the newer installations, although it requires a triple system of pipes. Both methods are in use in Boston and New York. In the method in which ammonia is distributed the tightness of all joints is very important, as leakage may entail losses that would make the enterprise unprofitable. Some companies use joints welded with the aid of thermite and insert expansion joints at intervals. The iron pipes through which the ammonia flows are inclosed in tile pipes which rest on concrete foundations. It is rumored that a French company will establish a system of distribution of cold in Cairo, Egypt. The project includes a central station for the condensation of ammonia, 3 miles of pipes for the distribution of the liquid ammonia to a number of substations, where it will be used to refrigerate brine, and 20 miles of pipes for the distribution of the cold brine to consumers.

### Expansion of Valves at High Temperatures.

The results of experiments to determine the expansion of valves and fittings in service involving high temperature are given by the Valve World. Three flanges were taken, one of cast iron, one of ferro steel, and one of steel. They were exposed to varying degrees of heat for a period of 130 hours, the temperature being less than 500 deg. for 18 hours, 500 to 700 deg. for 97 hours, 710 to 800 deg. for 12 hours, and over 800 deg. for 3 hours. The average for 130 hours was 583 deg. The view previously put forth by the Valve World was that cast iron subjected to continued temperatures of approximately 500 to 600 deg. takes a permanent expansion and does not return to its original volume when cooled. The results of the above mentioned experiments are stated as follows: Cast steel flange—no change. Cast iron flange—outside diameter increased 19-1,000 inch, inside diameter increased 7-1,000 inch. Ferro-steel flange—outside diameter increased 33-1,000 inch, inside diameter increased 17-1,000 inch.

### The Current Supplement.

SUPPLEMENT No. 1714 opens with an article by Percival A. Hislam on the new Russian armored cruiser "Rurik." Allerton S. Cushman contributes a splendid paper on electrolysis and corrosion, in which he develops his theory that rusting is an electrolytic effect. John J. Macfarlane summarizes the foreign trade in automobiles, and shows how remarkable has been the development of the industry. The well-known British fuel and gas expert Prof. Vivian B. Lewes contributes an article on the comparative thermal value of various fuels. Lubrication and lubricants are discussed by Dr. P. Martens. The anatomy of the "Mauretania" is the subject of a picture which represents a longitudinal section through the most modern of transatlantic liners. Francis Ward shows how the markings and colorings of fish protect them from their enemies. How plants may be forced by warm baths is told by Prof. Hans Molisch. The English correspondent of the SCIENTIFIC AMERICAN shows what the working cost of the Renard road train is per day. There are few natural phenomena so impressive to spectators as the total eclipse of the sun. For this reason eclipses have affected mankind strangely. Samuel Jennings shows what the relation of solar eclipses to ancient history has been.

### The Death of Samuel D. Burr.

Samuel Devere Burr died at Plainfield, N. J., on October 28. He was born January 23, 1855. He received the degree of Civil Engineering from Rutgers College, and later the degrees of Bachelor and Master of Arts. For three years he was connected with the Engineering News, and was a valued member of the SCIENTIFIC AMERICAN'S staff for six years. He left the SCIENTIFIC AMERICAN to fill a position on the staff of the Iron Age, where he remained for sixteen years. At the time of his decease he was connected with Metal Industry.

During these years he assisted his father with two volumes on the Centennial Exposition, wrote "Bicycle Repairing" and "Tunneling Under the Hudson," also "Rapid Transit in New York City and in Other Great Cities" for the Chamber of Commerce.

The Pennsylvania Railroad forestry department has just completed its forestry planting for this year. It is stated by Railroad Men that 625,000 trees were planted. This makes a total of 2,425,000 trees set out by the Pennsylvania Railroad up to the present time. The object is to create an adequate supply of timber for ties required in years to come. The Pennsylvania Railroad evidently is taking active steps in regard to the preservation of natural resources. The true way of preserving our forests is not necessarily not to use them, but to replant them.

# Correspondence.

### TWIN PROPELLERS ON AEROPLANES.

To the Editor of the SCIENTIFIC AMERICAN:

In your editorial criticism of the Wright aeroplane, issue September 26, you say that "the distribution of the thrust between two propellers, placed on either side of the center of gravity, constitutes, as this terrible accident has too clearly shown, a constant invitation to disaster." Also, you further say that one centrally-placed propeller would obviate the risk. Now I have been a student of aviation since 1878, and consequently can follow intelligently the process of reasoning that decided the brothers Wright to adopt the now condemned arrangement of a dual drive, and I cannot see but that, in their case, it was the best arrangement.

In their earlier gliding machines for private experimentation, these inventors always lay prone, using their hands and feet for guidance. But evidently they decided, against their better judgment, that this position was not one of sufficient dignity to assume before the eyes of the multitude, hence the seated posture of both operator and passenger. Possibly too they regarded a feet-first sitting position as having some advantage in case of accident, increasing their chances of landing right side up. But their decision had this result: *The propeller had to be removed from a position in front of them*, both on account of its unpleasantness, and also because of the dissipating effect upon the reacting currents, which in their case should be directly, horizontally rearward; consequently, if the position of the propeller was shifted upward, downward, or to one side of the center of resistance, it must be balanced by another of equal thrust at an equal distance from the said resistance center. Moreover, there is no reason why it should not work as Mr. Orville Wright said it would, discussing the probable outcome of just such a one-sided break. He is quoted as saying: "It would have a tendency to turn the machine from its course, but I would shut off the power and glide to the earth." Whether the nervous strain and a sense of peril to which he had subjected his esteemed fellow-passenger acted to confuse the operator, or whether some part was broken that was necessary to the guiding mechanism, is not known, I believe; but *he did shut off the power*, so why should the result be different with but a single propeller?

I believe that automatic balancing arrangements would have saved the situation; and where such rapid and precise action is needed, it should not be left to the operator, who has enough to attend to in steering.

Personally, I never had any use for screw propellers on aeroplanes, as they are wasteful of power, dangerous, and interfere with gliding evolutions. It is, I think, a safe prediction to say that in three years there will not be one in aeroplane practice.

St. John, N. B., October 8, 1908. J. E. FRASER.

### WAS THIS AN AEROLITE?

To the Editor of the SCIENTIFIC AMERICAN:

At 10 o'clock Tuesday morning, September 8, a noise was heard in the air above certain parts of middle Tennessee that seemed to indicate the passage of an unusually large aerolite over the section. The noise of the meteor (if meteor it was) was heard over the counties of Franklin, Coffee, Warren, and Grundy, and perhaps beyond the borders of these counties, which cover a superficial area of about 1,500 square miles. Your correspondent was at the time about seven miles south of Tullahoma on the Nashville, Chattanooga & St. Louis Railway. From that point the sound seemed to originate at an elevation of about 20 deg. in the north, and to travel eastward over an arc of about 50 or 60 deg., being audible for the space of a full minute. The sound was described by some as similar to the long heavy roll of thunder with three loud explosions or detonations in the midst of it, dying down very quickly after the last. Many persons who were at the time indoors, 50 to 150 yards from the railroad, thought a collision had occurred head-on between two heavy freight trains in the midst of the village. Still others thought that a large shipment of dynamite had exploded at a distance of several miles, and others, that terrific explosions had taken place in some of the coal mines in the vicinity. The sound could not properly be said to have only been distinct. It was, in fact, almost deafening, and interspersed with the three explosions, it crashed and roared away in—to many—a terrifying manner, apparently toward that part of the escarpment of the Cumberland Mountains which intervenes between McMinnville and Chattanooga.

There were no clouds in the sky at the time, and no trains near the point where your correspondent was. Moreover, the distance over which the sound was heard, at and near the same time, seems to have been at least fifty miles, and possibly much more. It was accompanied by a slight jar or vibration.

I have said that the sound, from Estill, seven miles south of Tullahoma, appeared to travel from north to east, starting at an elevation of 20 deg. and tending eastward and downward. This is the testimony of all. Now Beersheba, in Grundy County, and Altamont, in the same county, are situated on the plateau some 1,000 feet above, and 50 miles southeast from Tullahoma and Estill Springs; and at those points the sound is described as being not so loud as at Estill Springs, but, most interesting of all, they report there that it seemed to be low down as if it were a somewhat distant explosion in the earth, and to reverberate through the mountains as in a general course from east to west. If that particular point has been accurately reported, allowing for some error as to course, it would tend to locate the course of the meteor after the manner of tracing the flight of bees. It would show that it passed over certain points at no great height, and possibly fell somewhere on the mountain side in the vicinity.

So great was the interest and excitement created by the aerial disturbance that citizens telephoned and telegraphed to and fro from town to town, seeking information, and it is the chief subject of query and discourse to this day at the places mentioned.

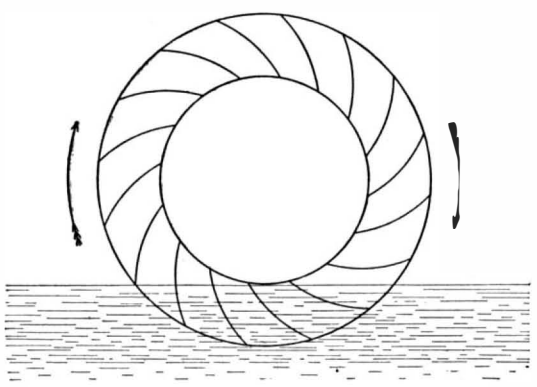
Now, undoubtedly all accessible data about this meteor ought to be gathered at once. Indeed it is not known but that it may be possible to find the place of impact, and possible fragments.

Nashville, Tenn. PARK MARSHALL.

### A PADDLE WHEEL FOR GLIDING BOATS.

To the Editor of the SCIENTIFIC AMERICAN:

After reading in the SCIENTIFIC AMERICAN an interesting article on gliding boats, the thought occurred to me that the screw was not perhaps the propeller best adapted to them. I believe that the type of paddle wheel shown in the accompanying figure would, in the case of gliding boats and only in that case, reduce the waste of power attending the use of the ordinary paddle wheel. Whenever a considerable segment of the latter is immersed, the effect of the



A PADDLE WHEEL FOR GLIDING BOATS.

paddles is, at the same time, to raise, to propel, and to sink the boat, both the raising and sinking efforts being useless. In the case of the modified paddle wheel, the raising and propelling effects only are left, and, in gliding boats, both are wanted. It might be worth trying to propel one of these boats with four such wheels arranged in two sets, as the rollers in Mr. Bazin's ill-fated rolling boat.

San José, Costa Rica. GUSTAVE MICHAUD.

### High "Villages."

To the Editor of the SCIENTIFIC AMERICAN:

In the issue of September 12, which is just at hand, is an article under the caption "Villages Situated at Great Altitudes," which is calculated to make a Coloradoan smile. The altitudes mentioned are scarcely worth noticing in this State, where one standard-gage railroad reaches an altitude of 11,660 feet, one narrow-gage, ordinary type, attains 14,007 feet; and a rack railroad reaches a height of 14,147 feet.

I herewith give a list of "villages," all in this State, together with their populations and altitudes:

| Town. | Population. | Altitude. |
|---|---|---|
| Sherrod | 100 | 11,423 |
| Ivanhoe | 30 | 10,928 |
| Kokomo | 350 | 10,654 |
| Leadville | 12,455 | 10,197 |
| Cameron Junction | 400 | 10,040 |
| Independence | 600 | 9,800 |
| Cripple Creek | 14,000 | 9,591 |
| Silverton | 1,360 | 9,285 |
| Ward | 300 | 9,217 |
| Silver Plume | 775 | 9,188 |
| Ouray | 2,196 | 7,706 |
| Denver | 180,000 | 5,309 |

This list might be extended to great length and still include no towns below 8,000 feet.

As to the highest habitations, I am unable to give figures, but they probably can be found far above 12,000 feet.

Altitudes of peaks, passes, etc., reached by rail in Colorado:

| | Railway. | Gage. | Al'tude. |
|---|---|---|---|
| Pike's Peak | M. & P. P. Ry. | narrow rack | 14,147 |
| Mt. McClellan | Argentine Central | narrow | 14,007 |
| Corona | D., N.-W. & P. | standard | 11,660 |
| Alpine tunnel | C. & S. | narrow | 11,596 |
| Boreas Pass | C. & S. | narrow | 11,470 |
| Ivanhoe | C. M. Ry. | standard | 10,944 |
| Marshall Pass | D. & R. G. | standard | 10,846 |
| Tennessee Pass | D. & R. G. | standard | 10,240 |
| Cumbres | D. & R. G. | ..... | 10,003 |

Denver, Colo. LEROY FIREBAUGH.

### What the Designer of an Aeroplane Ought to Consider.

The pages of Engineering have been enlivened for some weeks past with a number of letters from aeroplane inventors, some of them of no small reputation, which letters have drawn together much scattered information obtained from experimental and other sources. In one of the recent issues of our contemporary Mr. Frank Hambling attempts to clear the air of controversy and to anchor a few principles, which, in his opinion, ought to be kept in mind by aeroplane enthusiasts. These are his principles:

1. An aeroplane must have sufficient combined speed and plane to raise its intended load, together with its own weight.

2. The greater the speed the less the plane, and the less the necessary angle of that plane for the same effect.

3. To counteract the resistance set up by the means of gaining momentum while on the ground, which is additional to the resistance the machine will have when once clear: (*a*) extra power is required, or (*b*) extra plane surface to meet the power we have; (*c*) a better effect for the power we have; (*d*) an outside agency that will assist. Extra power means more weight; extra plane means more resistance; better effect for the power we have means an improvement in the engine or means of propulsion; an outside agency means a fixed starting-point.

Mr. Hambling accepts (*c*) a better effect for the power we have, as the correct course.

4. The planes must always be sufficient to permit of a safe landing.

5. Their exact shape depends upon the type of machine constructed, the means employed for obtaining lateral and longitudinal balance and stability, and varies so greatly that no rule can be laid down.

6. The planes should be constructed of material as strong as the end in view permits, and should in themselves create as little *useless* resistance as possible.

7. The general arrangement should be as simple as the design allows.

8. The control should be simple and easy of manipulation.

9. The balance should be automatic.

10. Although it is highly improbable of attainment, we must not overlook the fact that a means of keeping afloat without engine power perfects the aeroplane.

The chief points unsolved (without 10) and receiving attention are:

The engine.

The means of propulsion.

The raising.

The balance.

Given a good means of propulsion, and an automatic balance, the aeroplane will be as reliable as its engine—a speedy, safe, and cheap means of conveyance.

### A Floating Compass Needle.

If a thoroughly dry and clean sewing needle is very carefully laid on the surface of water in a basin, says Kosmos, the needle will float, in spite of the high density of steel—seven or eight times that of water.

On close inspection it is found that the surface of the water is depressed under the needle, very much as if there were a thin film stretched over the water, and slightly indented by the weight of the needle. This property of liquids, of offering a certain assistance to a force exerted upon their surface, is termed "surface tension." The magnitude of the force of surface tension varies from one liquid to another. It is greatest in the case of mercury. The cause of the phenomenon must probably be looked for in the attraction of the liquid molecules to one another. A sewing needle, thus floating upon water, may be used as a compass, if it has previously been magnetized. It will then point north and south, and will maintain this position if the containing vessel is moved about; if the needle is displaced by force, it will return to its position along the magnetic meridian as soon as the restraint is removed.

Registrations of automobiles with the Secretary of New York State in securing licenses for the current year are less by 200 than last year. Up to July 1 last year there had been 8,225 registrations.

## ELECTRIC SCRUBBER FOR CLEANING SHIPS' BOTTOMS WITHOUT DRYDOCKING.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

Innumerable devices have been invented to clean a ship's fouled bottom without the necessity of docking. The success achieved has been only moderate. The old-fashioned hogging brushes, with which the submerged parts of wooden ships used to be scrubbed, palliated matters somewhat, but did not quite surmount the difficulty, simply because sufficient force could not be applied to the brushes, and for the reason that with equal force their scrubbing power is very much less for reasons to be explained.

As the old-fashioned hogging brush was dragged along, the brooms had the tendency to be bent aft, and thus to a certain extent to ride over at any rate the harder patches of fouling matter. This was due to the principle of the process of scrubbing, the brush, like the ordinary carpet broom, being pushed in advance of the sweeper. As is well known, it is not possible to sweep a carpet quite clean in this manner without going over the ground several times. If, however, the carpet broom be turned in the hand and used against the lay of the bristles, it sets up a flick. It is this latter principle which has been adopted in the design of the electric scrubber to be here described.

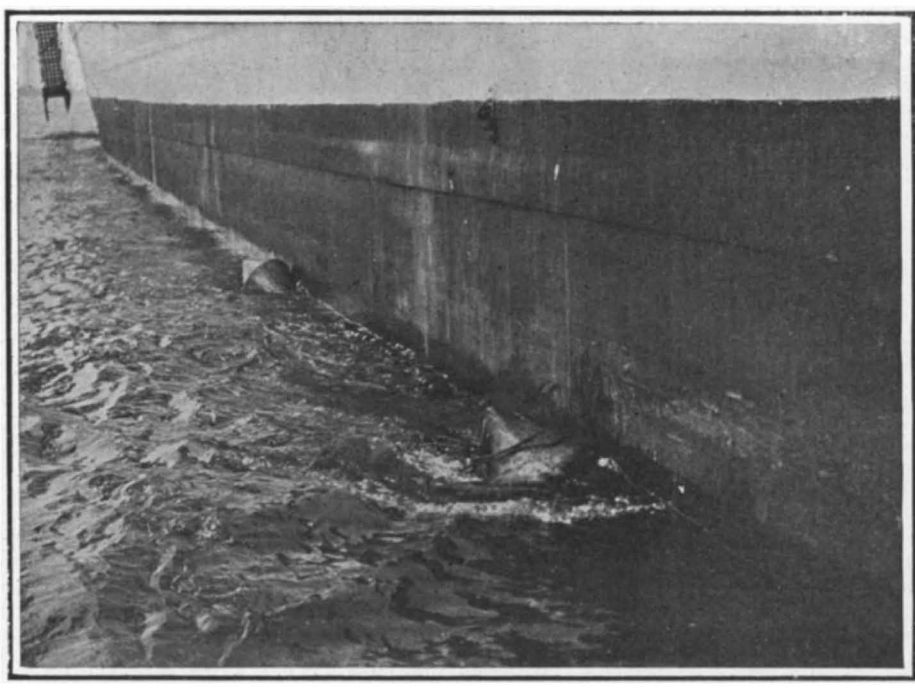
The principle of the appliance is very simple. It is in effect a flexible hogging brush, which is dragged up and down under the hull of the ship by ropes. By the use of electricity the brush is made to cling to the ship's side like a magnet. The "mat," as the group of brushes is called, comprises a series of battens carrying the brushes and magnets. These are threaded at either end on chains, and separated from one another by cork disks, also threaded on the chain, to assist in giving the necessary buoyancy to the apparatus, and to avoid injury to the battens from short-circuiting, which would result if two battens came into contact. At each end of these threading chains is a chain bridle, to which the hauling hawser is shackled. The hawser at each end passes through a fair-leader block, which is shackled to a position chain, and so is taken to a steam winch. One position chain passes right round the ship near the bow, and the other near the stern, while the hauling hawsers are seen fore and aft on the ship's side, with the mat in working position amidships.

The mat itself has a leading batten without a magnet at either end, and six ordinary battens each fitted with two magnets and a set of brushes between. In the mat illustrated there are also two dumb battens, which are incorporated to adjust the buoyancy. In the photograph of the mat itself, it will be observed that the leading battens have each two large brushes set square and in way of the magnets upon the other battens. These brushes clean those parts of the ship which would otherwise be untouched by the brushes of the central battens, and also clear a path for the magnets. On the central battens the brushes are set diagonally, one-half being skewed to the right and the other half to the left. In this manner any tendency on the part of the mat to run crooked is counteracted.

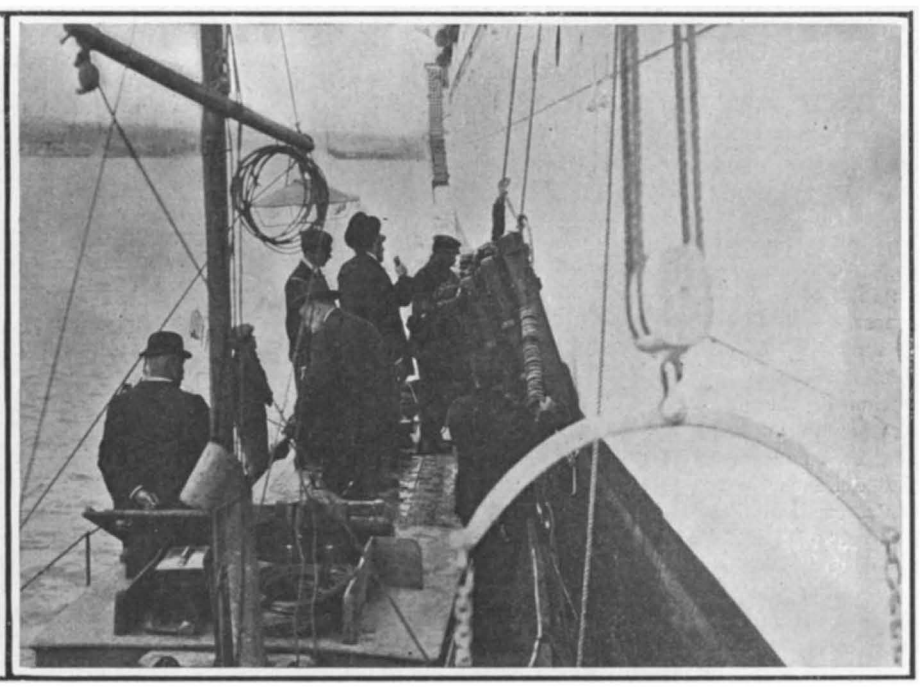
When the mat is slung over the vessel's side and lowered into position, the electric current is switched on. In this position the apex of the curve of each magnet comes into contact with the ship's side and secures a grip thereon, but the brushes are not touching. As soon as hauling commences, however, the battens cant, thus bringing the fore edge of each brush into touch with the hull of the ship. As it is dragged over the fouled surface, the accumulated matter is flicked off. At the same time, of course, the fore side of each magnet becomes engaged. The backs of the battens are so designed as to insure this canting or rocking; and since the mat has to travel indifferently fore and aft, the arrangement has to be double ended. Thus each leading batten has its back made with one bevel on its outer edge, but each middle batten has both edges beveled.

The requisite current is furnished either from the ship itself or from a special tender equipped with the apparatus lying alongside. From actual experience it has been found that the total magnetic grip of the whole mat is well over one ton. A test made with a single magnet on the hard-steel cover of an ammunition hoist proved that the pull amounted to 280 pounds. It was also found that a single batten when attached by its magnets to a ship's side was able to support safely the combined weight of two men. Experience has shown, moreover, that a greater grip is requisite for the very hard steel of modern armor plates than for ordinary steel plates used in the construction of a mercantile vessel's hull. The strain on the hauling hawsers fore and aft is approximately 1.5 tons.

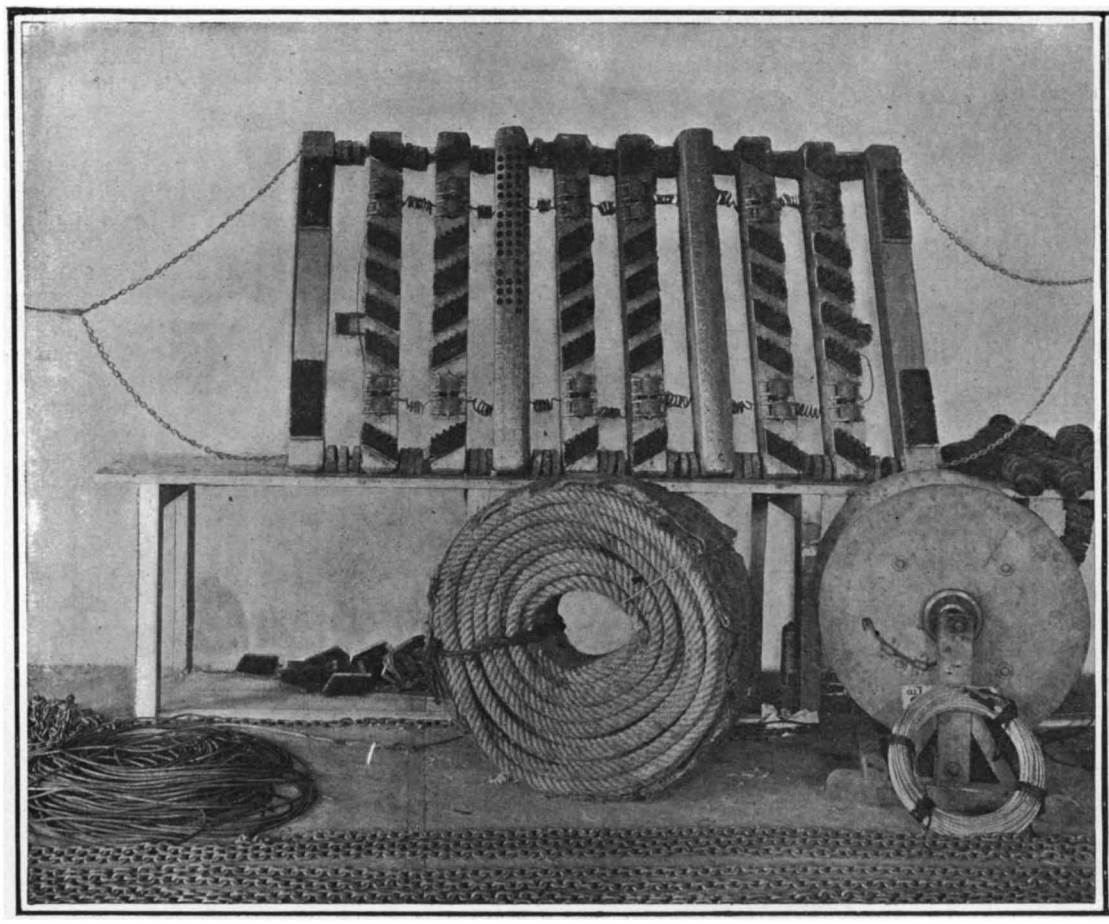
The scrubber requires the attention of only two or three men to work it, and it carries out its task quickly and thoroughly. An 18,000-ton battleship can



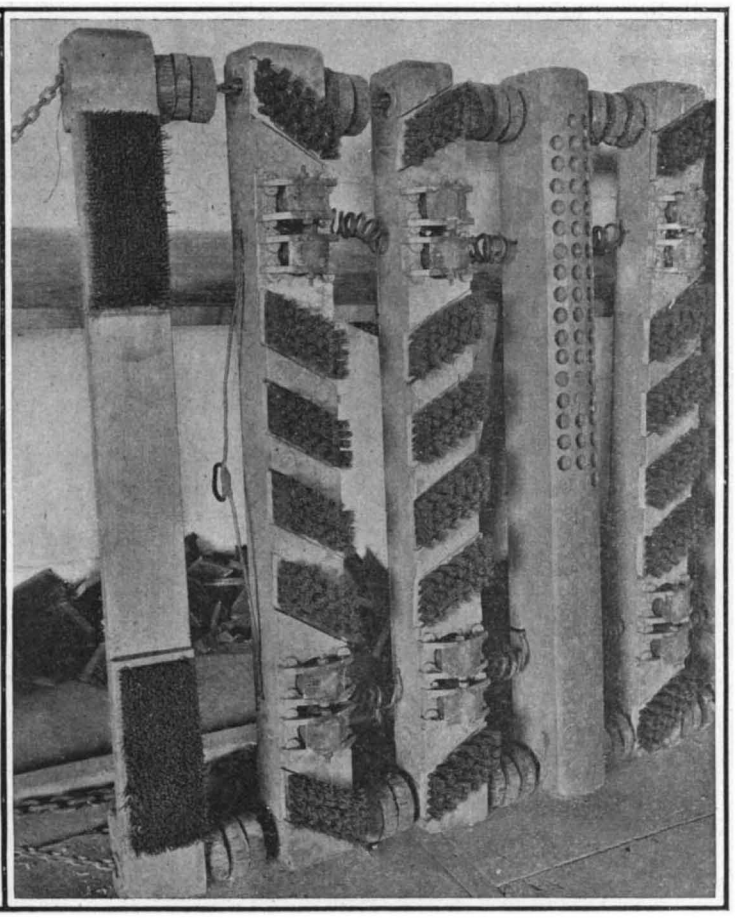
Floating the scrubber fore and aft. Ten tons of shell and weed were removed from one side alone of this steamer.



Lowering the electrical scrubber from the tender. Current in this case is supplied by the tender. It may also be supplied by the ship itself.



The complete gear, showing the mat carried on chains with insulating cork disks between to prevent short circuiting.



Details of mat, showing outer battens with diagonal brushes, magnets, and dumb battens in center.

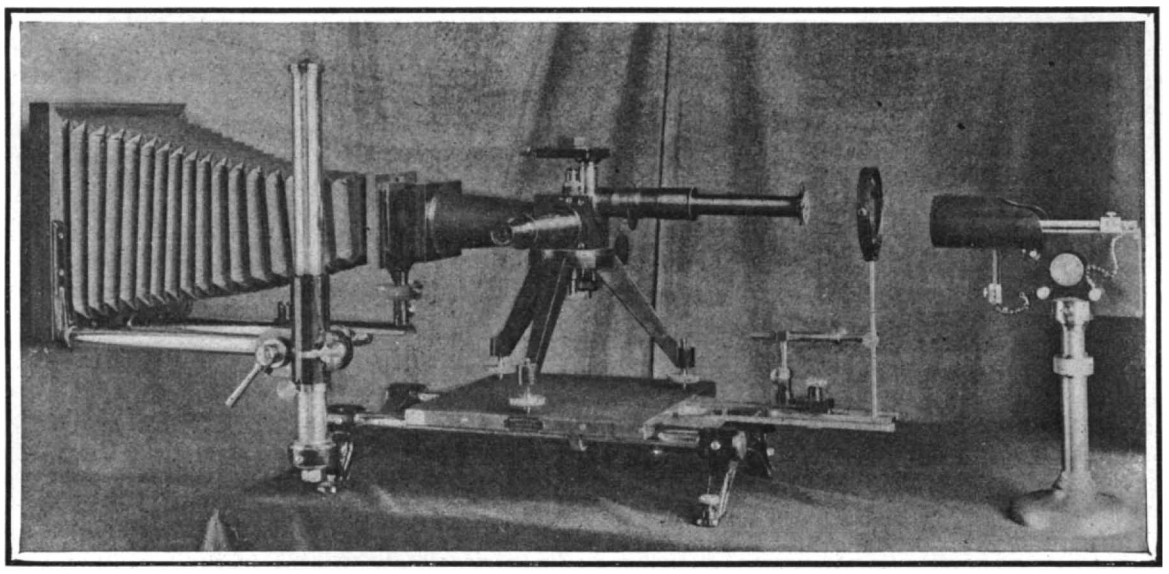
be completely scrubbed in twelve hours, and vessels drydocked after being cleaned by this method have been found to be entirely free from any marine growth. The gear itself is simple and strong. Its manipulation does not call for any special skill. This enables it to be used by a ship's company if desired; in fact, in connection with warships the sailors have successfully carried out the operation. As, however, in the case of merchantmen the services of the whole crew are generally required for other duties, small tenders equipped with the requisite gear are being stationed in ports ready for instant service. It is then only necessary for the cleaning tender and crew to make fast alongside the vessel and carry out the scrubbing operations, while the crew themselves are occupied in the loading or the unloading of the ship under treatment.

The cost of cleaning a vessel by this method is low. A 4,000-ton ship can be cleaned, inclusive of the provision of labor, current, and all gear, for $100 in approximately eight hours, though this cost would be appreciably lower were the vessel being cleaned to supply the requisite current and had steam on her own winches to operate the hawsers.

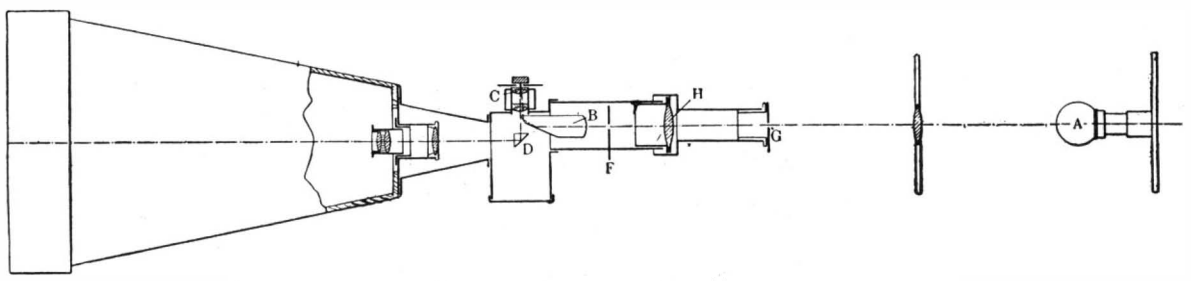
## METALLOGRAPHS, OR PHOTOGRAPHS OF THE STRUCTURE OF METAL SPECIMENS.

BY J. F. SPRINGER.

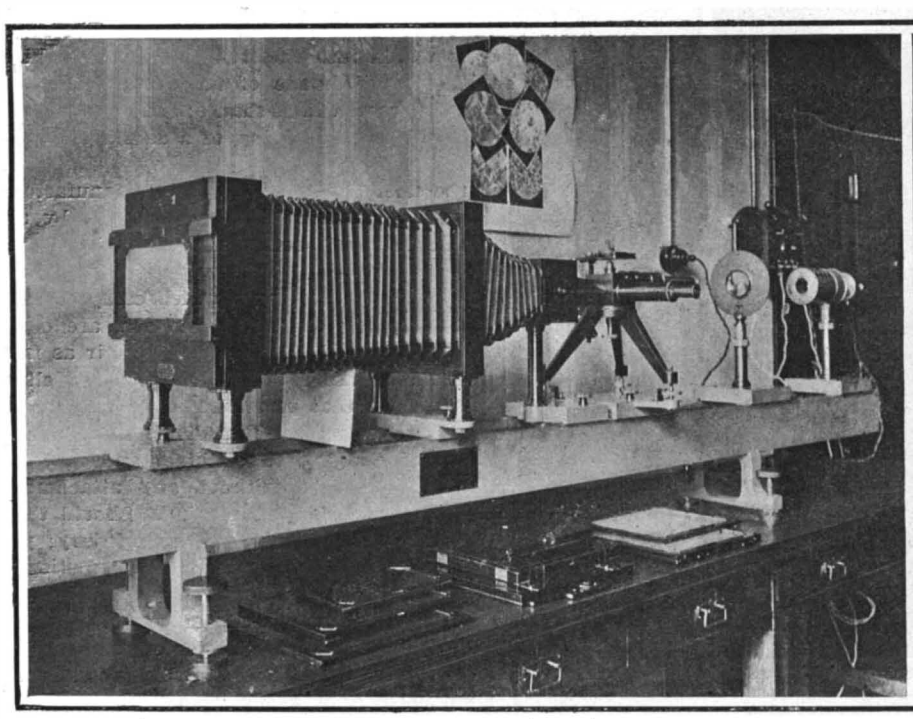
In recent years an entirely new branch of practical science has grown up, to which the name of *metallography* has been given. A *metallograph* is a pictorial representation disclosing the structure of a metal specimen. It has long been known that much might be learned of the characteristics of, say, a piece of steel by the mere optical examination of the structure disclosed by a fracture. The difference in appearance of a fresh fracture of hardened and tempered razor steel from a fracture of, say, cast iron is quite apparent to the eye. But in order to study this line of things with effectiveness, some means of recording these appearances was necessary. This has been filled by photography. An unmagnified representation — made by photography or otherwise —of a metallic fracture is called a *macrograph*. One of the illustrations shows a photographic apparatus suited to the production of macrographs. This vertical arrangement is especially desirable, as thus the sunlight may readily illumine the surface of a fracture. The specimen is seen in the figure lying—fracture side up—upon the table. The whole camera may be adjusted vertically along the post rising from the base by means of the locking arrangement. The focusing is accomplished in connection with the rod on the upper right hand.



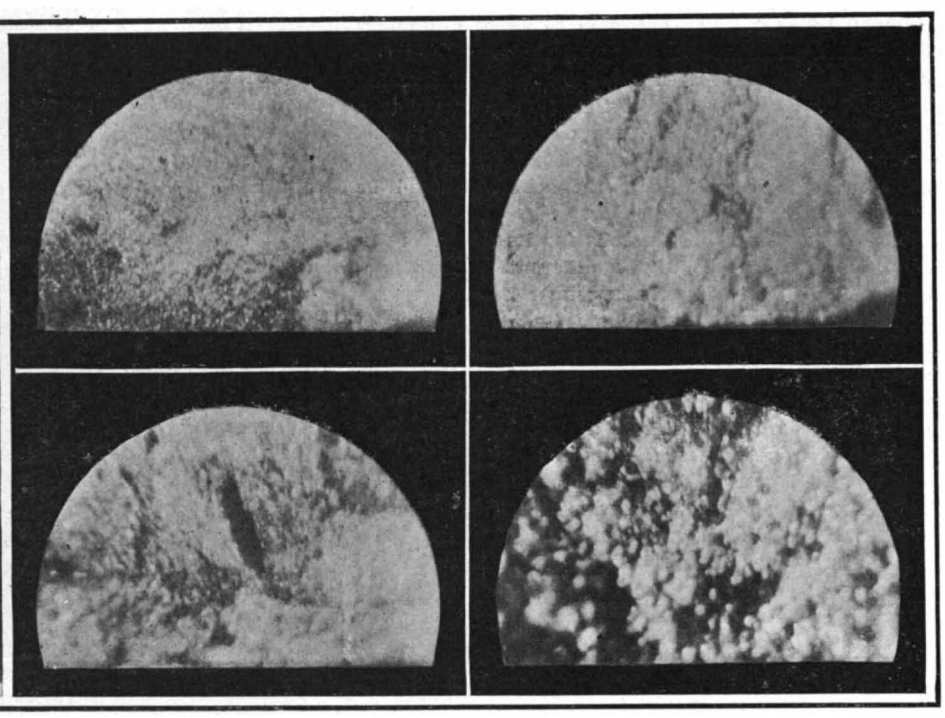
Chatelier apparatus for making metallographs using "Liliput" focusing arc lamp as source of light.




Diagrammatic view of the Chatelier system of microphotography.

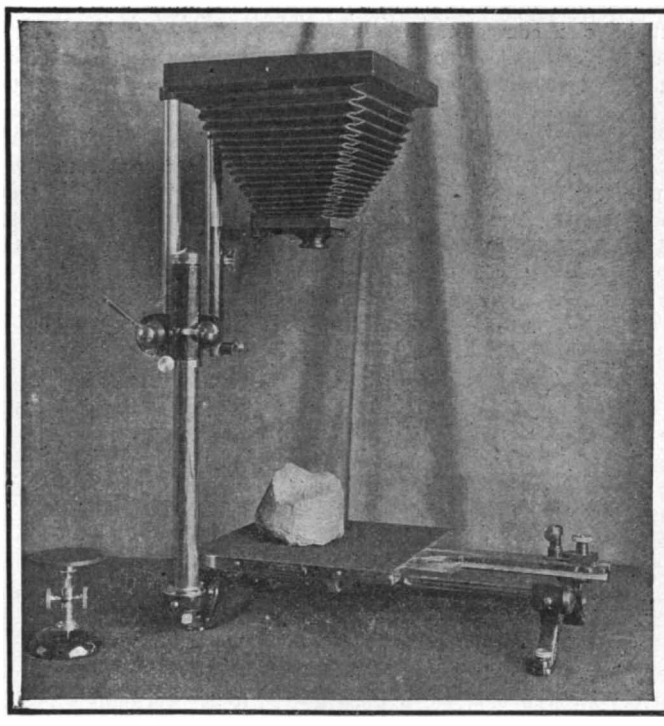


Nernst lamp used with the Chatelier microphotographic apparatus.

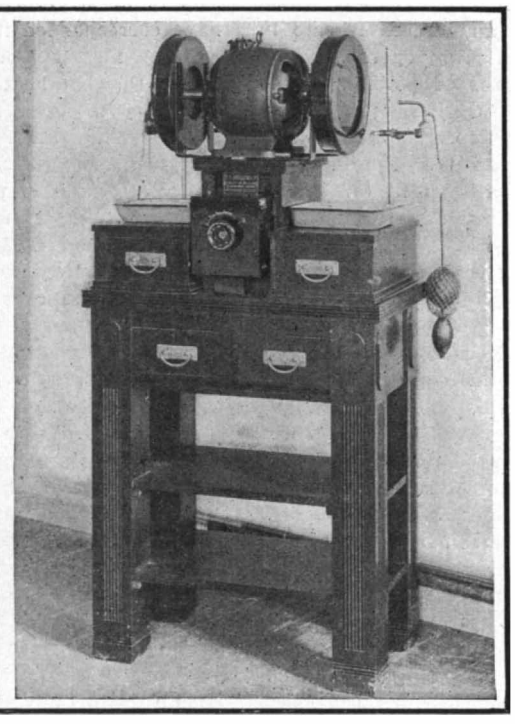


Micrographs of 1.65 per cent carbon steel, showing effects of overheating.

The loud and manifold complaints against the London motor omnibus have impelled the leading companies to action. A new species of inspector has been created—a speed inspector. His duty is to watch for omnibuses traveling at a speed beyond the companies' maximum of 12 miles an hour, and to report the offenders to headquarters. For purposes of identification each motor omnibus will carry a distinctive mark, a small board with certain capital letters—ON—S, for example — clearly painted upon it. This is fixed at the side of the omnibus above the window, at the end near the driver. The General and Vanguard motor omnibuses wore their identification boards for the first time last month.



Camera taking macrograph of a fracture of specimen.



Electric polishing machine for preparing specimens to be microphotographed.

However, while the study of macrographs is no doubt of considerable importance, the present state of the study of metallic structures would have been hardly possible of attainment through them alone. The microscope has been brought into this line of research, and with the most important results. A magnified representation of a metallic fracture is called a *micrograph*.

Now it might seem to some that with chemical analysis on one hand and mechanical testing on the other, there would be little that could not be learned about metals by means of one or the other of these processes. That this is not the case may be seen from the fact that metallography

is making a place for itself by the intrinsic value and uniqueness of its information. The chemist could tell us, no doubt, that a given specimen of steel contained just so much iron, so much carbon, so much silicon, and so on to the last minute impurity. The mechanical tester could inform us as to its capability of withstanding compression, of its resistance to tension, of its degree of hardness, and so on. Now if our piece of steel were an absolutely homogeneous, noncrystalline substance, the metallographist would probably have nothing to add. But steel and many other metals have a definite structure. In fact, the micrographs show that it is a most complex substance—not complex merely from the fact that it contains quite a number of different substances, but because it is an aggregation of substances which differ from each other in form and characteristics. In other words, steel is not a perfect chemical compound. Metallography not only informs us of this fact, but instructs us as to the form of the structure.

It is found, particularly with steels, that the structure varies with the heat treatment to which the specimen may have been subjected, with its chemical constitution, and with the mechanical operations which it has undergone. Thus, the percentage of carbon influences the structure. A great variety of structural changes is brought about by heating, chilling, overheating, and the like. Cast steel, steel hot forged under the hammer, and steel cold rolled, all differ in structure. The expert metallographist is able, in fact, to discern from his metallographs a good deal as to what has happened to the steel under inspection.

Now it is not quite so easy a matter to make a micrograph as it is to make a macrograph. It is necessary to prepare the specimen for microscopic inspection; and it must be flat and highly polished as a preliminary to the final processes.

There are four methods of preparing the test piece: (1) it may be etched with acids and the like; (2) it may be polished in bas relief; (3) it may be polished by "polish attack"; or (4) it may be tinted by heating.

To etch the surface, nitric acid, iodine, or picric acid may be used. The object is to affect differently the different substances making up the complex structure exposed by the fracture, with a view of creating different optical conditions, so that when exposed to a strong light the etched surface will disclose in the microphotograph light and dark effects corresponding to the structure. Ordinarily, the surface should be carefully polished before etching.

Polishing in bas relief depends for its success upon differences in hardness of the different parts of the complex. Upon treating the specimen to a series of polishing operations—proceeding from a rough polishing with files to that obtainable with emery papers and rouge—it is possible to produce a surface free even from microscopic scratches, which will yet be unequally worn in detail although flat as a whole. This is considered a very fine method—especially applicable to certain cases. Thus, Prof. Stoughton points out that this method is particularly advantageous in differentiating the graphite in pig iron, as it does not produce the discolorations to which an acid etching might give rise. In preparing his own specimens, he performs all the polishing operations, except that with the rouge, by hand. There are, however, one or more varieties of apparatus for accomplishing this by mechanical means.

The method of preparation called "polish attack," as used by F. Osmond, of Paris, consists in performing polishing operations by means of parchment which has been treated with a little ammonium nitrate in solution. This method is a finishing operation, and is performed after coarser means of polishing have been used.

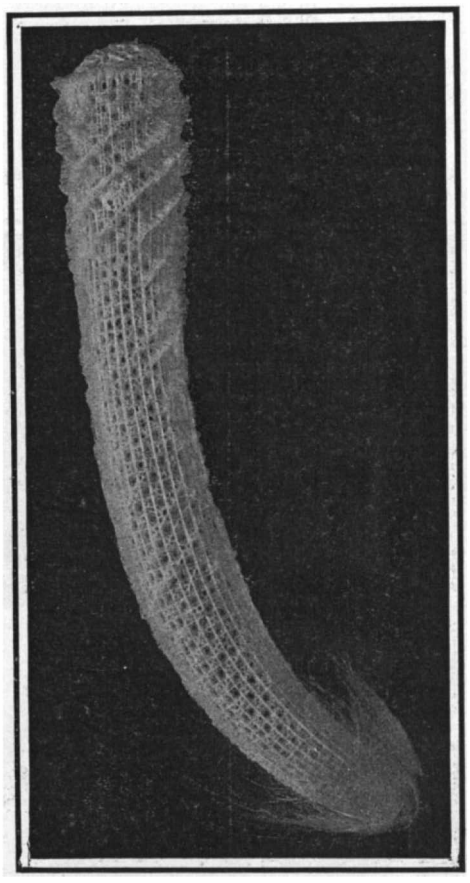
The process of tinting by heat depends upon the fact that upon application of warmth the different constituents of the polished surface will oxidize differently, thus producing differentiating effects discernible by the photographic plate.

F. Osmond, of Paris, is one of the leading metallographers. He recommends the application of a series of finishing operations. Thus, after the preliminary preparation of the specimen, it may be treated to polishing in the bas relief, then to "polish attack," and finally to the action of chemicals. Photomicrographs may be made after each stage.

However, whatever process or combination of processes is employed, the problem of preserving a record is solved by the use of a magnifying apparatus in combination with a photographic camera. In the line cut we have a diagrammatic representation of the method of Le Chatelier. The microscope is at *C*. The specimen may be seen almost in contact with the outer—or object—glass of the microscope. The great difficulty in this application of photography is the illumination of the object. In micrography the specimens are seldom, if ever, transparent, so that the light must fall upon them on the same side as that which is presented to the object glass of the microscope. In the Le Chatelier process of microphotography, an artificial light is set up at *A*. There is a diaphragm at *G*, but intervening between *A* and *G* a condensing lens is set up. Its office is to gather a multitude of rays and focus them at *G*. This condensing lens may be seen in the half-tone engravings as a separate piece of apparatus, off to the right. The light next falls upon the lens *H*, whence it passes through the diaphragm *F*. The prism *B* now receives the light, and totally reflects it through the microscope upon the specimen. Thence it is reflected back through the microscope to the prism *D*, whence it is totally reflected into the object glass of the camera.

One of the engravings shows a series of photomicrographs. These all relate to the same piece of steel, although the micrographs were made from different portions. One part of the whole specimen was overheated and then quenched. As the piece was unequally heated, the temperatures at quenching varied. These have been estimated. This specimen was a pure carbon steel of 1.65 per cent carbon. Notice the size of the grains in the last of the series. That these changes in appearance correspond to variations in physical properties will be understood from the fact that the hardness numbers corresponding to the portion represented by the micrographs varied from 105 for the first down to 70 for the last. The tests for hardness were performed by the scleroscope—the hardness-testing instrument described in the SCIENTIFIC AMERICAN for August 29, 1908. It will be seen that metallography affords a precise method of determining what has been the heat treatment of steel whose chemical analysis is already known.

This brings us to another point. If the specimen just described had been a steel of, say, a different



GLASS-SPONGE.

percentage of carbon, it would have disclosed a variation in its structure, but this line of variation would have corresponded to its own composition. We could not say merely from observation of the size of the grains to what heat the steel had been heated. It is necessary to know its chemical constitution in addition.

It seems to have been pretty well ascertained that the finest grain of pure carbon steels is developed at about the temperature of 1,300 deg. F. As this temperature is exceeded the size of the grain continually increases, and apparently with great regularity. If the steel has been overheated, and has consequently developed a large grain, this serious fault may usually be corrected by cooling below the temperature just mentioned and then reheating to some point above it. When the heat of 1,300 deg. F. is just reached, the fine grain begins to form. If the steel has a carbon percentage of precisely 0.9, a few degrees in excess will be sufficient ordinarily to cure the large-grained structure. But if the carbon is much below 0.9, then the heating will have to go considerably beyond, 0.4 carbon requiring a temperature of about 1,470 deg. F. If the carbon percentage is quite low it may be necessary to heat to 1,600 deg. F. or somewhat beyond. The reason for heating beyond 1,300 deg. F. is that steels having less than 0.9 carbon are composite in their structure, and heating to 1,300 deg. F. does not uniformly affect the whole mass. The old grain size (developed by the overheating) tends to persist. If the steel has more than 0.9 carbon, the necessity for heating above about 1,300 deg. F. to effect restoration is not pressing—the imperfection from want of uniformity being but slight. It is evident that the new science of metallography is eminently adapted for investigation into this whole matter of size of grain.

It may, however, be gathered from the foregoing that no method of investigation—whether chemical, metallographic, or mechanical—stands absolutely alone. To have full and definite information, it is necessary to have the co-operation of all. And even then, we may fall short of having a complete statement; for none of these practical sciences is to be regarded as having reached its final stage. Science is ever going on to a higher goal.

## SOME COMMERCIAL USES OF THE GLASS-SPONGES.

BY L. LODIAN.

The glass-sponges of the Oriental tropical seas were first described among spongiæ as a curiosity about a century ago; but their commercial uses in the far East are unknown to the Western world even to this day.

What asbestos is to us, the glass-sponge débris is to the Asiatic. In fact, asbestos is not found in the far East, if we except the poor short-fiber mineral mined on the Asiatic versant of the Ural range—many thousands of miles distant from the habitat of its marine competitors, the uplektela, or glass-sponges.

These odd glass-silk sponges grow in the warm tropical seas of the Pacific like ordinary sponges, from the Fujiyama region to the Indian Ocean. Specimens have even been fished up in our own Antilles. The Japanese call them mineral-silk sponges; and some are a mere bunch of cords like a skein of twine, with none of the exquisite, complex, snow-white, built-up lacework of the cornucopia-shaped glass-sponge. However, they are all allied to the homely sponge which is used in our bath-tubs. But with what widely-variant, different uses! The far-eastern article is raked up for its fiber and débris, the latter forming a heat-insulator for steam pipes. In recent years it has been used with even better results in cold-storage insulation, and is considered as efficient as magnesia or asbestos. It is of course cheaper. The separated fiber is woven into chemical filter-cloths, which would be destroyed if made of animal or vegetable fibers; into fireproof candle-shades; and even into delicate fireproof chintz curtains, of a dazzling, glossy white.

Whether the fiber can be used in the manufacture of gas-mantles, is a matter to be determined by experiment. The idea apparently has never been carried out.

Specimens of the glass-sponges which escape breakage, and are secured intact from the sea, are occasionally sold to tourists, or woven in the hair as fantastic ornaments by the natives. The sponges cling so readily to fabrics, that sometimes they are merely laid on the breast as decorations. Thus they have a singular habit of clinging to clothing, and may be carried around for hours without any attachment other than their own natural fastening. Should they fall on a stone floor, they would suffer no injury; yet if stepped on, they would be crushed to destruction—leaving, however, the long fiber fairly intact.

Some of the glass-sponges reach an extreme length of nearly forty inches and a diameter of four inches. Broken and trimmed-up pieces of the big growths are used as lamp-globes and shades; and whole plants have been used in some of the city homes of the natives for receiving two or three bulb-lights. A very charming effect is the result.

They are easily cleaned by simply holding them under the faucet of running water.

The specimen of the glass-sponge here illustrated was originally enveloped (as an ear of Indian corn is enveloped by its husks) in silky fibers, a tuft of which remains at the base. These glossy and almost indestructible fibers are prized too much by the Orientals to be allowed to remain. Moreover, they would completely obscure the marvelous serrated corrugations, like little flounces with delicate frilled edges, terminating the upper part of the sponge, as here illustrated. The fibers are especially valued for spinning and weaving (mingled with the yet longer fibers of the twine-sponges—also pure silica) into the beautiful silk-gauze zephyr-cloths of Chinese inland commerce.

### German Picture Post Card Industry.

Consul-General T. St. John Gaffney, of Dresden, states that the exportation of German picture post cards has recently diminished considerably. The foreign demand is, however, still great, amounting to about 500,000,000 since the beginning of the year to July 1. Compared with the previous year, this shows a diminution of 150,000,000. The United States is said to be Germany's best customer, followed by England. Asia and Australia are also good patrons of this form of art industry.

Safe flywheel diameter in feet equals 6,000 ÷ (3.1416 × revolutions per minute).

# Handy Man's Workshop

The Editor of Handy Man's Workshop will be glad to receive any hints for this department and pay for them if available.

## HOLDER FOR BROKEN SHANK DRILLS.

BY A. FAGAN.

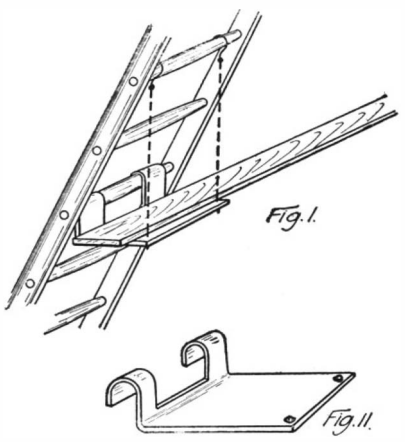
A convenient drill holder that may be fitted to an ordinary carpenter's boring brace can be made as follows: Take a piece of soft steel about two inches long. File it tapered to fit the brace. Bore a hole in the larger end to a convenient depth and to size of

HOLDER FOR BROKEN SHANK DRILLS.

drill to be held. File slot in side and to the center of the holder as shown, with the front edge of the slot flush with the end of the drill hole. Grind the end of drill flat at one side as far as center, so that when the drill is placed in the holder the flattened end will project beyond the drilled hole and engage the bottom of the slot. With this device broken shank drills may be utilized to advantage.

## A PAINTER'S PLATFORM BRACKET.

When painting the side of a house or a building, it is not always convenient to rig up a platform, supported from the eaves or roof. It may also be a one-man job, in which case a platform of that nature would be inconvenient anyway.



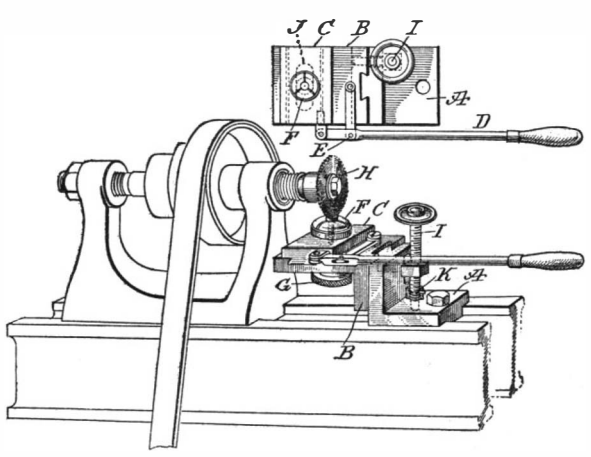

A SIMPLE SUPPORT FOR A LIGHT SCAFFOLD.

The following contrivance has been used with every satisfaction: Fig. 1 is a view looking at the under side of the ladder, to better show the bracket in use. The plank stretches across to a similar contrivance, attached to a second ladder not shown. One end of a plate is cut as shown in Fig. 2, and bent into the shape of a hook, to fit over the rounds of the ladder. Two holes are made in the opposite corners for the chains. The other ends of the chain are furnished with hooks, to reach the rounds of the ladder above the level of the platform.

## SCREW-SLOTTING ATTACHMENT FOR LATHES.

BY H. D. CHAPMAN.

The accompanying drawing suggests a method of converting an old lathe or speed lathe into a screw-slotting machine.



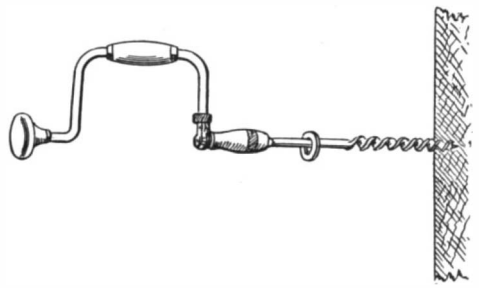

SCREW-SLOTTING ATTACHMENT FOR LATHES.

The angle plate *A* is secured to the bed of the lathe. In the vertical face of angle plate *A* is a dovetail groove, in which angle plate *B* fits, so as to afford an up-and-down motion. On the top face of angle plate *B* is a dovetail groove, in which slide plate *C* operates. Lever *D* pivots on swivel *E*, giving movement to slide plate *C*. Place the screw to be slotted into draw chuck *F*, and tighten on draw wheel *G*. With the fixture so placed on lathe bed as to cut the screw central, the depth of the slot may be regulated by adjusting screw *I*. By moving the lever *D*, the screw is fed into saw *H*. There is an elongated slot *F* in angle plate *B* to allow the draw clutch to pass through and move back and forth on slotting screws. In angle plate *A* is a stud *K* to hold in position the adjusting screw *I*.

By a little practice the screws may be slotted very rapidly, as I have observed in the shop where I work.

## A GUIDE FOR DRILLING HORIZONTAL HOLES.

A large washer makes a good level for drills to show whether the hole is being drilled horizontally. Place the washer on the shank of the drill or bit, and then



A GUIDE FOR THE BIT STOCK.

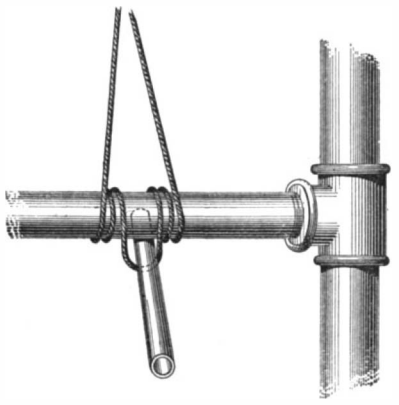
if it feeds forward or backward while the bit stock is being operated it indicates that the bit is tipped upward or downward, respectively. When the bit is held horizontal, the washer will remain stationary. The washer should be free from burrs, and the opening should preferably be turned true.

## SUBSTITUTES FOR A PIPE WRENCH.

BY J. A. BERGSTROM.

The accompanying illustration represents an improvised pipe wrench, very simple, yet effective, one that will fit the largest or smallest pipe. It may be used on brass or iron pipe, without marking or defacing the same.

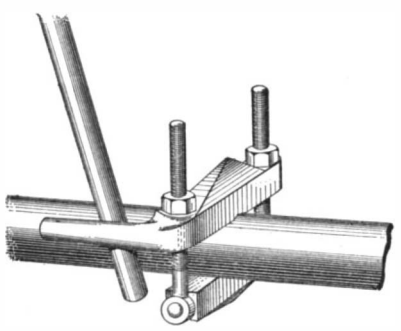
A sling or a short piece of rope is made double



IMPROVISED PIPE WRENCH WHICH WILL NOT MAR THE PIPE.

and passed around the pipe three or four times, as shown in the illustration, leaving a short loop in the middle. Into this loop is inserted a short piece of pipe or a stick far enough to pass the center of the pipe. The loose ends of the rope are held tight with one hand, while the short piece of pipe or stick is held in the other. Now the tighter the loose ends are pulled, the tighter the rope will hug the pipe, and it will be possible to exert quite as much pressure on the pipe with this arrangement as with an ordinary pipe wrench. To be sure, it will largely depend upon the strength of the rope. This may of course be doubled or trebled, according to the size of pipe to be screwed home. When working on polished brass or steel pipes, a little resin may be put on the rope, which will increase the friction, or one or more turns around the pipe will answer the same purpose.

Another improvised pipe wrench consists of an ordinary lathe dog secured to the pipe. The turning of



A LATHE DOG AS A SUBSTITUTE FOR A PIPE WRENCH.

the pipe may be done with a monkey-wrench or a short piece of pipe or a stick inserted between the shank of the lathe dog and the pipe.

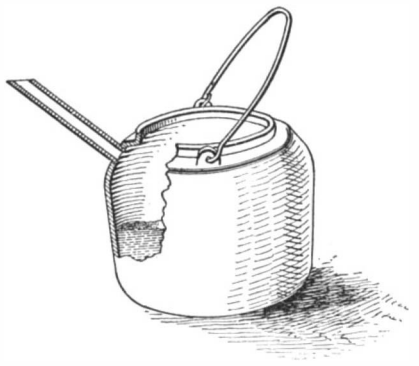
In close quarters, of course, the dog will have to be opened and turned on the pipe little by little.

## OLD GLUE POT AS A METAL POT AND LADLE.

BY A. V. SEARING, JR.

A very handy metal pot for which no ladle is needed may be made by taking the outer part of a glue pot, and drilling a hole near the top, which is to be tapped to receive the threaded end of a piece of ⅛ or ¼-inch gas pipe. The opposite end of the pipe should be beveled to form a convenient spout.

With this device bearings may be babbitted which would be very difficult to get at with an ordinary ladle. The pipe forms a handle which may be seized with the pliers when pouring the metal. To preserve

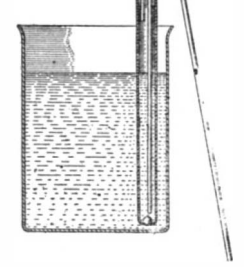


OLD GLUE POT AS A METAL POT AND LADLE

its usefulness as a glue pot, insert a cork or wooden plug in the end of the gas pipe.

## STARTING DEVICE FOR SIPHONS.

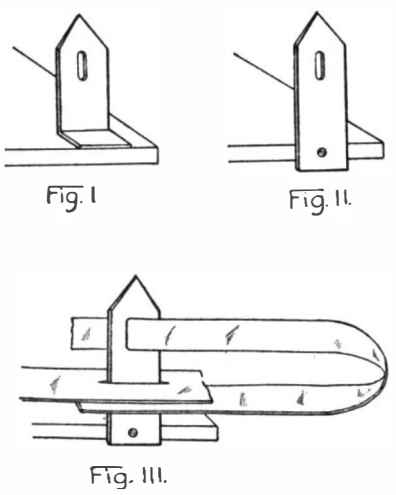
How to start a siphon running is sometimes quite a problem. If the liquid that is to be siphoned off is harmless, the siphon tube may be filled by suction with the mouth at the end of the longer arm. But this is not always very pleasant, and sometimes it is even dangerous if the liquid is of a poisonous nature. The accompanying engraving illustrates a method by which the siphon may be started by compression instead of suction. The idea is so old that probably it is new to many. The device consists of a large test tube, in the open end of which a cork is fitted, while in the opposite end a small hole is cut by means of a file. A glass marble is placed in the tube, and serves as a valve to close the opening. Through the cork the shorter leg of the siphon is run, and also a small bent tube. The outer end of the latter tube is placed in the mouth, and on blowing into the test tube the compression serves to close the valve and at the same time force the liquid through the siphon. As soon as the pressure is relieved, the liquid in the vessel will flow up through the opening in the test tube, and continue running off through the siphon. The shorter leg of the siphon extends to within a short distance of the ball valve, so as to limit the motion of the latter, and prevent it from striking the glass with a blow sufficiently hard to break it.



STARTING DEVICE FOR SIPHONS.

## RAG CARPET NEEDLE.

The strips of cloth for making rag carpet are usually formed into a long string or rope by stitching the ends together with cotton or thread, a process not only tedious, but taking no little time. To obviate this, a little tool, or needle, can easily be made from a small piece of clock spring, the end of an old table




RAG CARPET NEEDLE.

knife, or any thin piece of steel. Make the needle about one inch and a half long, and either turn it up at right angles to form a foot, by heating it in the fire first, or drill a hole in one end for an ordinary wood screw. In the former case, a thumb-screw clamp

can be used to hold the needle to the table. The other end of the needle is to be formed with a V-shaped point, fairly sharp. Just below the point a slot is made about one-eighth of an inch wide by half an inch long, or long enough to pass the ends of the pieces of cloth through.

To sew the pieces together, which can be done very rapidly, after a little practice, press one end of a length of cloth down upon the needle until it passes the eye. Likewise, one end of another piece is pressed down upon the first. The other end of either piece is then threaded through the eye for a short distance, as shown in Fig. 3.

The whole is then lifted up until the threaded end falls below the other two, when it is pulled all the way through.

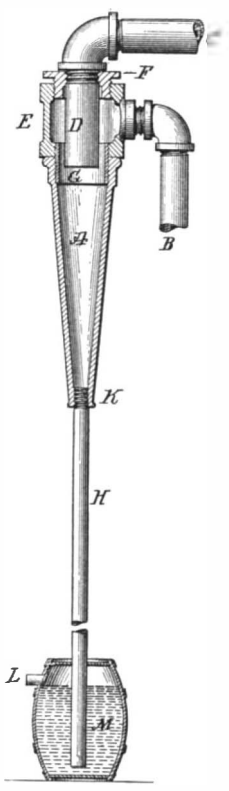
It will be found that these joinings are perfectly flat and satisfactory.

Figs. 1 and 2 show the two styles of clamps, one with a foot, to be held to the table by means of a thumb-screw clamp, and the other with a screw attachment, to be held to the edge of the table by means of an ordinary wood screw.

## HOME-MADE VACUUM CLEANER.

BY W. J. C.

The installation of a vacuum cleaning system in private houses entails at present a considerable expense, as it includes the purchase and maintenance of a gasoline engine and vacuum pump. If the latter two machines were eliminated, and a simple method of obtaining the required vacuum devised, this great labor-saving device would be much more in evidence, even in homes of moderate size.




HOME-MADE VACUUM CLEANER.

This object can be realized by use of the ejector or ordinary barometric condenser used in connection with the city water supply or from a tank.

The entire arrangement can be built at the rear of the dwelling, and does not take up more room than an ordinary leader pipe.

The illustration shows the arrangement of the device. *A* is an ordinary hose nozzle 12 inches long, with thread for 3-inch iron pipe on large end and tapped for ½-inch pipe on smaller end.

By means of the nipple *G* it is connected to a 3 x ¾-inch tee, which is bushed on the opposite end to 1 inch. This bushing has a 1-inch pipe *D* extending from the inside and ending as shown in the cut just inside of nozzle. The other end of *D* protrudes through the bushing *F*, and is then run as afterward described. The smaller end of the nozzle carries a ½-inch pipe *H*, which forms the down leg of the ejector. The apparatus is placed so that the point *K* is at least 34 feet above the cellar, forming the barometric column. The pipe *B* is connected with the water supply, with a conveniently situated valve to regulate the flow.

The pipe *H* is carried down to a seal pot *M* situated in the cellar. This can be made of a barrel with an overflow to sewer, as shown at *L*.

The pipe *C* is carried to a vacuum reservoir, which can be situated either in cellar or attic, preferably the latter, as it means a saving in piping and less joints to provide chance of leaks. This pipe is connected to top of reservoir, and the service pipe to the various rooms also comes from the upper end, but extends to within 12 inches of the bottom.

The service pipe has a connection for rubber hose, with valve at each floor.

In order to obtain the required vacuum, all that is necessary is to turn on the water in the pipe *B*, when the descending column in *H* causes a partial vacuum in the reservoir and in the service pipes.

Care must be taken that all joints are made perfectly airtight in service pipes and in *C*.

The reservoir must also be airtight. It can be made of a kitchen boiler with a small handhole cut in the bottom to remove dust which collects within.

The ejector can be placed outside without danger of freezing if precaution is taken to break the vacuum when through using, thereby emptying the down leg of all water.

The down leg need not be straight if the first bend is at least 10 feet from the nozzle.

This device is not intended to supply a vacuum cleaning system for large buildings, but rather for private dwellings, and can be put up by anyone accustomed to handling pipe and competent to make good tight joints.

## A STEREOSCOPE FOR SINGLE PHOTOGRAPHS.

BY PROF. GUSTAVE MICHAUD, COSTA RICA STATE COLLEGE.

Some stereoscopic relief is usually perceived when a photograph is examined at a very short distance through a pinhole. The relief is increased when the drawing or photograph shows some positive distortion, but however strong may be that relief in some cases, it always disappears at once when both eyes are used, with or without pinholes. The impossibility to get binocular stereoscopic relief in such circumstances has for probable cause the very fact which makes it possible to get stereoscopic photographs; the image of a protruding or receding object which is not far from us is not the same for each one of our two eyes. The right eye sees more of the right side of the protruding object; the left eye sees more of the left side. Whenever both images are identical, everyday experience has taught us to consider the object as perfectly flat, although it might be the faithful reproduction (so far as outlines, shades, and color are concerned) of a long rifle directly aimed at us. That the object is near, we instinctively infer from the converging effort our eyes are making; that it is flat is none the less evident, as both eyes see it alike in spite of its proximity. One eye might be deceived; two eyes cannot be as long as they are obliged to converge and, while so doing, get two different images of any *true* relief.

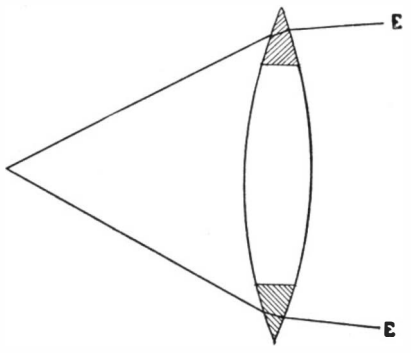



Fig. 2.—BINOCULAR VISION THROUGH A LARGE LENS.

Would the result be the same if some artifice were used to prevent them from converging while examining simultaneously, through two diaphragms, a flat drawing or photograph? To give an answer to this question, the writer has devised an apparatus which is a very simple piece of work and requires but a minute or two for its making. It does not seem at first to deserve the name of stereoscope for single photographs, as it requires two pictures. One and the same negative, however, is used to make both of them, and the two pictures on Fig. 1 differ from ordinary stereoscopic photographs in being identical.

In a rather large piece of dark-shaded pasteboard, two circular holes are cut out. Their diameter should be about ½ of an inch, and the distance between them (this being measured from their centers) should be exactly 2½ inches. Fig. 1 is placed at a distance of about two feet from the eyes, and the piece of pasteboard with the holes at about six inches from the eyes. Through the holes the observer looks at the two pictures without making any effort to see them distinctly, his eyes being completely at rest, as if they were directed in an absent way toward some far-away object. As this is being done, the two holes seem to get nearer each other, and at last will merge into one and the same hole. So will apparently the two photographs, and relief will be manifest.

The experiment throws some light on the hitherto unexplained cause of the relief which appears when a photograph is examined through a lens large enough to allow binocular vision through its two opposite marginal parts. Such relief is probably the direct consequence of the decreased convergence of the eyes. The same explanation holds good for the relief obtained with two convex prisms which act exactly as the opposite segments of a large lens, the eyes being in *E E* (Fig. 2). Parallelism of the optical axis of the eyes seems again to be the only sound explanation of the relief perceived when Javal's iconoscope or Giraud Teulon's binocular ophthalmoscope is used to examine flat drawings. In all such apparatus the convergence of the optical axis is decreased or suppressed, and the eyes are thereby prevented from applying the only test by which they can readily distinguish the real object from its *facsimile* drawing or photograph.

Some people (about one in every four, if a limited number of observations is to be trusted) cannot obtain the fusion of the two images. On putting on a pair of convex spectacles, such observers generally get the desired result. The explanation of this curious fact probably lies in the difficulty we meet in dissociating the convexity of the crystalline lens from the convergence of the eyes. When we are looking at some near object, the eyes become convergent and the crystalline lens becomes more convex. When we are looking at a considerable distance, the axes of the eyes become parallel and the crystalline lenses are flattened. Thus an intimate connection is established between the convergence of the eyes and the convexity of the crystalline lens; and to exact at the same time increased convexity of the crystalline lens because the object is near, and parallelism of the eyes as if the object were far away, is for some people as difficult a task as it is for anyone to move independently the fingers of both hands during a first piano lesson. Convex lenses relieve the crystalline lens from part or from the whole of its task; this is probably the way in which they contribute to the fusion of the two images during the experiment just described.

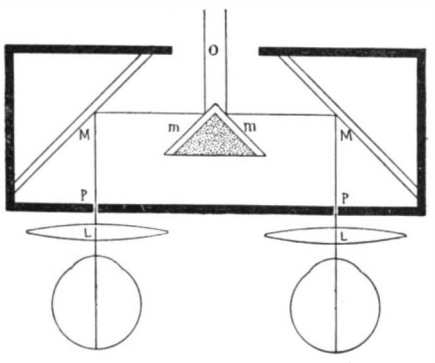



Fig. 3.—A POWERFUL STEREOSCOPE FOR SINGLE PHOTOGRAPHS.

The strongest binocular relief which can be had with *single* photographs or drawings requires the use of an easily made little apparatus, the main features of which are two pinholes, *P P* (Fig. 3), four mirrors, *M*, *M*, *m*, *m*, and two biconvex 3-diopter common spectacle lenses, *L L*. The localization of the rays in the crystalline lens and the exaggerated curvature of the focal surface are produced by the opening in *O*, far from the eyes, and by the pinholes in *P P*, which allow to bring the picture within a reduced distance from the apparatus. The parallelism of the optical axis is obtained, as in Javal's and Giraud Teulon's instruments, through two consecutive reflections of the luminous rays. The more or less complete relaxation of the crystalline lens is produced by the lenses placed between the pinholes and the eyes. If they are suppressed, the relief does not much decrease, but then a considerable number of observers fail to get the two images to coincide. As in the case of the piece of pasteboard, one must look into the apparatus as if the object to be seen were far away and without making any effort to see it.

Fig. 3 is on the scale of six inches to the foot. The inside of the box containing the mirrors must be blackened. The mirrors are kept in place with straps of black paper. Although standing below the average in manual ability, the writer made his own apparatus without meeting any greater difficulty than the exact setting of the small mirrors vertically and at a horizontal angle of 45 deg. with the sides of the box.

Fig. 1.—THESE PHOTOGRAPHS ARE IDENTICAL BUT SHOW STEREOSCOPIC RELIEF WHEN VIEWED THROUGH A DOUBLE DIAPHRAGM.

## RECENTLY PATENTED INVENTIONS.

**The Inventions described in this Department were Patented through the Scientific American Patent Agency.**

### Pertaining to Apparel.

STOCKING SUPPORTER.—T. PAPWORTH, Portland, Oregon. This supporter is provided with a pair of jaws which may be attached to the underwear and a link locking device which may be attached to the sock or stocking. The device may be applied wherever convenient to hold the hose taut on the limbs of the wearer.

### Electrical Devices.

ELECTROLYTE.—A. VAN WINKLE, Newark, N. J. The invention provides a new electrolyte for use in the electro deposition of zinc on iron and steel. The special object of the invention is to provide increased conductivity of the solution and to improve the color of the deposit as well as to insure a perfect plating, especially on concave surfaces.

### Of Interest to Farmers.

MARKER ATTACHMENT.—L. R. TURNER, Long Pine, Neb. An efficient marker attachment for corn planters, and the like, is provided by this invention. The marker indicates the positions to be occupied by rows of plants or hills, and can be automatically disposed in a number of positions.

### Of General Interest.

COMPOSITION FOR SOLIDIFYING FLUE DUST.—S. W. RAMSEY and G. W. SMITH, Youngstown, Ohio. In the operation of blast furnaces for the reduction of iron there accumulates a considerable quantity of dust which consists of small particles of oxid of iron, coke, and other constituents of the furnace charge. The present invention has for its object to convert this dust into bricks so that the iron it contains may be reduced.

BUILDING BLOCK.—A. G. MAHLER, Medford, N. Y. This building block is adapted to be quickly laid in constructing walls and is provided with improved means for connecting or bonding the adjacent blocks. The block is also designed to facilitate the application of plaster on the inner side of the wall, and affords a free circulation of air from the interior of the walls to the outside without allowing the admission of rain.

EMBROIDERY FRAME.—G. B. LYON, Ithaca, N. Y. This is an improvement on hand embroidery frames that are composed of a hoop and a clamping device for holding the fabric stretched thereon. In the present invention the hoop is constructed with flanges at each edge between which the clamp is applied. The latter is made of a transversely corrugated strip of elastic metal.

DEVICE FOR AUTOMATIC FIRING OR SELF-LOADING ARMS.—S. H. BANG, 24 Pehlenschlaegersgade, Copenhagen, Denmark. The invention refers to a trigger mechanism in connection with self-loading fire arms by means of which the gun may be made to act either to fire a single shot each time the trigger is pulled, or to fire automatically as long as the trigger is acted upon.

GATE VALVE.—G. H. BENTON, Metuchen, N. J. The construction of this gate valve is very simple and its operation effective. It is arranged to compensate for any inequalities in the seats and the gate faces, to insure at all times a firm and active seating of the valve gates to prevent leakage, and to allow convenient opening and closing of the gate valve.

WIND ACTUATED ADVERTISING DEVICE.—R. RAY, Carrollton, Mo. This advertising device is adapted for outdoor display of moving signs. It consists of a windmill, provided with the customary vane for directing the wheel into the wind and the vane is arranged to receive advertising signs.

### Hardware.

SASH FASTENER.—H. ATWATER, Chattanooga, Tenn. The fastener provided by this invention is adapted to be mounted upon the meeting rail of the lower sash and lock both sashes in closed condition. The fastener is strong and conveniently operated and may be adjusted for locking either sash opened more or less, as may be desired.

### Heating and Lighting.

BURNER.—W. H. DAMON, New York, N. Y. An improvement in hydrocarbon burners for heating rivets is provided by this invention. The burner is formed with air and fuel passages, a combustion flue surrounding the burner proper having air intake openings in the side and bottom, and a regulating device closely fitting the flue and having like openings in the side and bottom, the openings of the flue and of the regulating device being movable alternately into and out of register.

### Household Utilities.

FURNITURE.—F. N. CHURCHILL, Spokane, Wash. The invention relates to a table of simple construction which can be neatly folded. When collapsed it can be shipped or stored without danger of injury to the parts, and at the same time requires a minimum of space.

SAD-IRON HEATER.—G. W. FALLIN, Montgomery, Ala. The body of this sad iron is hollow and carries an alcohol generator, and an alcohol burner. An alcohol generator is first heated to produce alcohol vapor and this is then burned to heat the sad iron. The upper face of the sad iron is thus heated from the inner side, and when it has attained the proper degree of temperature the body of the iron is inverted. While this side is being used the other surface of the iron is heated by the burner so that it will be ready for use when the side in use becomes cool.

### Machines and Mechanical Devices.

WELL-DRILLING APPARATUS.—R. D. MOON, San Angelo, Texas. An improved mechanism for lifting the drill and permitting a quick and unimpeded drop of the drill bar is provided by this invention. The use of a high or top-heavy rigging is thus avoided, as well as the great jar and noise found in the use of ordinary rigs.

REVERSING MECHANISM.—T. H. and J. E. HOLGAN, New York, N. Y. The construction is applicable to shafts carrying drill chucks and the mechanism is such that as a drill or tap is brought into engagement with the work the drill shaft will be engaged automatically with the driving pulley in a manner to feed the drill or tap into the material, and as the work is withdrawn, the shaft will be brought into such relation with the driving pulley as to reverse the direction of rotation and withdraw the drill or tap from the work.

STONE SAWING MACHINE.—A. JONES, Oolitic, Ind. The invention relates to stone-sawing machines using rotating drums and endless traveling wires passing over the drums and serving to cut stone. The object of this invention is to permit of adjusting the wires conveniently and quickly in the desired position relative to the stone for cutting the latter into pieces of the desired width.

CONTINUOUS-DRAW VACUUM WINDOW-GLASS MACHINE.—D. H. HERSHEY, Latrobe, Pa. The invention provides a method for drawing glass in a cylindrical form suitable for flattening out to make window glass, also to a method of shaping the glass by producing a partial vacuum around the cylinder of glass as the latter is formed. Means are provided for maintaining a uniform diameter of the cylinder as it is drawn upward from the molten glass.

AUTOMATIC TRIP FOR CONVEYERS.—C. FREDERICKSON, Cameron, Wis. This automatic trip is arranged to operate at any predetermined place so that the material in the hopper may be deposited wherever desired. Should a wagon be under the cable of the conveyor the material may be evenly distributed therein without the necessity of moving the wagon.

MECHANICAL MOVEMENT.—S. JONES, East Liverpool, Ohio. A means for converting continuous rotary motion in one direction into alternate forward and backward rotary motion is provided by this invention. The new movement is adapted for use on washing machines, churns, and the like. It is arranged to automatically revolve a part of the machine, a predetermined number of times alternately, in opposite directions.

GRINDING MILL.—D. S. ANTHONY, Durango, Mexico. The object of this invention is to provide an improved mill more especially designed for grinding middlings and arranged to insure ready grinding of the corn, or other material, to any desired degree of fineness, and to allow easy sharpening of the grinding members.

MACHINE FOR FINISHING THE PACKING OF BARRELS.—L. STORCK, J. H. VOGT, and L. STORCK, Stamford, Conn. An improvement in machines for finishing the packing of barrels with pulverized or granulated material is provided by this invention. The machine is especially constructed to perform this operation on shipping cases which have been packed by a machine previously invented and patented by Messrs. Vogt and Storck.

SOUND BOX.—J. C. KERR, Valparaiso, Chile. The invention provides a sound box for talking machines in which practically the entire quantity of sound waves produced is forced to pass through the sound tube, and in which inharmonious or disturbing vibrations are avoided and all deadening of the sound waves is prevented.

PIANOFORTE.—W. R. T. HILL, Asheville, N. C. The invention provides an improved frame for pianofortes in which the tension on opposite sides of the frame is balanced so that the bending strain of the frame is eliminated, and the sound boards are made without ribs, the strings resting on the bridge at each end.

### Prime Movers and Their Accessories.

FEED WATER HEATER.—J. H. KIDWELL, Staunton, Va. This feed water heater is designed for use on locomotives and is characterized by the fact that it utilizes the exhaust steam from the cylinders for the purpose of heating the feed water as well as using the hot gases in the smokebox at the front of the boiler for the same purpose.

STEAM TRAP.—A. L. RIGGS, Ebensburg, Pa. This improved steam trap is arranged to insure a positive and easy working of the valve controlling the inflow and the discharge of the water and means are provided for holding the valve locked in one position until the trap is accurately filled with a predetermined quantity of water. The valve is then held in its other position until this quantity of water has been discharged.

### Railways and Their Accessories.

GRAIN CAR.—J. T. MCNALLY, Chicago, Ill. The car is designed to discharge the grain through a double bottom, provided with openings, the openings of one bottom being movable into and out of register with those of the other bottom. A door is adapted to cover these perforated bottoms when the car is to be used as an ordinary box car and this door is also adapted to cover one of the door openings in the side of the car when the car is to be used in hauling grain.

### Pertaining to Vehicles.

TRANSMISSION MECHANISM FOR MOTOR VEHICLES.—C. M. LEECH, Lima, Ohio. The construction of this mechanism is such that its operation will have no tendency to throw the driving shaft out of alinement and the movement of the vehicle both forward and rearward can readily be controlled and gradually varied, the transmission passing from a friction to a positive drive on shifting the gearing from slow to full speed.

SPRING SUPPORT.—T. J. FAY, New York, N. Y., and J. M. ELSWORTH, Bernardsville, N. J. The invention relates more particularly to specific means for securing the spring supports of motor vehicles to the body or chassis. An improved clip is provided in which the securing bolts are formed integral with the main body of the clip so that the breaking of a bolt will not loosen the spring and the spring will be firmly held at all times unless all of the bolts should become broken.

DRAY WAGON.—G. R. MCLERAN, North Yakima, Wash. This invention provides an improvement in dray wagons, such as are used for hauling heavy loads of all kinds. The axle of the wagon may be lowered by locking the wheels to the axle and the wagon when then moved forwardly operates to adjust the main frame over the axle. In this manner the load may be lifted and secured to the wagon.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Full hints to correspondents were printed at the head of this column in the issue of August 8th, or will be sent by mail on request.

(10956) A. H. N. says: If soft coal ashes be mixed with water to the consistency of mortar and then put in a round oak or other soft coal heater on a good bed of coals and the drafts opened, this mixture will burn freely. How do you explain this anomaly? A. There is always a considerable percentage of unconsumed fuel or combustible in ashes—especially soft coal ashes—even though they may appear to be free from coal; so that they will have a certain amount of fuel wherever they can be burned without clogging up a fire and choking the draft. The addition of a moderate quantity of water to a hot soft coal fire has a curious effect. If the temperature is sufficiently high, the water is decomposed, forming free oxygen and hydrogen, which later reunite at a point usually some distance above the body of the fire in a hot flame. No heat is actually added to the fire, the effect being to abstract the heat from the coals and give back the same quantity of heat in flame above the fire, oftentimes giving the appearance, however, of making a hotter fire. In cases where a long flame is desirable, as in fire under a steam boiler, it is a common practice to wet the coal before firing it, for this reason. These facts will probably help you to explain the phenomenon you have observed.

(10957) M. F. S. says: 1. Would you kindly explain the real meaning of the word "watt"? One says that a 16-candle-power lamp takes 56 watts, say 60 watts for convenience, per hour. If it takes 60 watts per hour, it should take 1 watt to light it for 1 minute. Yet we all know that it takes the full 60 watts to light it even for one second. A 300-watt dynamo does not give 300 watts per hour, it gives them all the time; if such a dynamo were connected with a watt-meter, would the watt-meter register 300 watts after an hour? A. A watt has no reference to time. It is the unit of electric power. And just as a horse-power works right along, a second, an hour, or any other time and is the same horse-power, so the watt is the same for any time. If a lamp requires 60 watts to light it, it will require the 60 watts for a second just as really as for a whole day. What is paid for on the watt-meter is the watt-hours. If 1,000 watts are used for one hour, that is a kilowatt-hour; and if for ten hours, the consumer must pay for ten kilowatt-hours. This too is just the same as the horse doing work. If one hires a horse which might do a horse-power of work, he will pay for the same horse working for the entire time which he does work. The idea seems simple. 2. Does the sun have any direct influence upon the weight of objects on the earth? Example: Will an object be theoretically heavier at midnight than at midday? A. The weight of objects does not vary from noon to midnight because of the position with reference to the sun. The change of distance from the sun in that time is so small as compared with the immense distance of the sun as to be of no value at all.

(10958) F. G. S. asks: Is there any simple formula for calculating the power of a magnet when the size of wire, number of turns, and E. M. F. of battery are known? Will this formula apply in the case of a solenoid? A. The tractive power of a magnet is found by the formula Pounds $= \frac{TCM\sqrt{A}}{2661\,L}$ in which $T$ is the number of turns of wire, $C$ the current in amperes, $M$ the permeability of the iron of the core, $A$ the area of pole pieces, and $L$ the mean length of the magnetic circuit. For a solenoid without iron the permeability is 1, since the permeability of the air is the standard of comparison, and hence is unity. For a straight coil the result will be of little value because of the great leakage of lines of force, and the great length of the circuit of the lines in the air.

(10959) J. H. S. asks: The difference between the work a 5 x 5-inch engine is capable of performing against what a 5 x 6-inch would do, both engines running equal speed, with valve lifts, compression, and all conditions being equal. The direct argument is that if two cars were built identical with the exception of the motor, one to be a 5 x 5-inch and the other to be a 5 x 6-inch direct connected, or in other words one-to-one speed, which car would be the fastest provided they were driven to their limit? Also, would you please explain how much faster a 5 x 5-inch would have to run in order to develop the same horse-power as a 5 x 6-inch; also what relation the piston speed bears to the horse-power of a motor. This last subject is one which seems to be very poorly understood; and while the writer is well aware just what relation it does have, we would like to have you give us an explanation of the matter. A. If we may take your last question first as the simpler, the relation of piston speed to horse-power is exactly the same in an internal combustion engine as in a steam engine, i. e., increase of piston speed indicates either decrease of load or increase of power generated in exactly the same proportion in one as in the other. Your first question cannot be quite as positively answered, for the reason that indicated horse-power has not quite the same relation to brake horse-power in internal-combustion as in expansion engines, partly, if not principally, for the reason that whereas in the latter the difference is entirely friction in the engine, in the former it includes overcoming of inertia in the three "dead" strokes including compression of the gas. For instance, an ignition at any later moment than the dead point decreases the area of the card, from which, if complete analogy with steam engine indication existed, a loss of power would be presumed, whereas it is found in practice that retarding the ignition up to a certain point increases the power measured on the brake. As far as your question is concerned, however, the difference in power between a 5 x 5 and a 5 x 6 engine at the same R. P. M. would depend upon only two interdependent variables, the mean effective pressure and the stroke. There would be a slightly higher pressure in the 5 x 6 before ignition, on account of a larger volume of gas having been inspired and compressed into the same space, but this may be neglected. For the purposes of calculation we must suppose the ignition to be at a point 1 inch from the beginning of the stroke in both engines, as without knowledge of the period of ignition we cannot otherwise calculate the relative volumes to which the gas expands. In the formula $\frac{plan}{33{,}000}$ = H. P., $p$ in the 5 x 5 engine = $\sqrt{p_1 \times \frac{p_1}{5}}$ and in the 5 x 6 engine = $\sqrt{p_1 \times \frac{p_1}{6}}$

$l$ = in the first case $\frac{5}{12}$ and in the second $\frac{6}{12} = \frac{1}{2}$

Therefore: H. P. of 5 x 5 engine : H. P. of 5 x 6 $:: \frac{5}{12}\sqrt{\frac{p_1}{5}} : \frac{1}{2}\sqrt{\frac{p_1}{6}}$

$= 0.186 : 0.204$; that is to say, the 5 x 5 engine has roughly 90 per cent of the power of the 5 x 6 at the same speed, and must therefore run about 9 per cent faster under the same load to deliver the same power as the latter. This is, of course, not an accurate figure, which cannot be obtained without a careful test by both indicator and brake, but it is a fair approximation, sufficient, we hope, for your purpose. The inaccuracy lies in the determination of the ratio of expansion.

(10960) A. L. T. asks: Will you be so kind as to inform me if it is possible or impossible to make a so-called permanent magnet out of a pure soft iron, i. e., a magnet, for example, similar to the steel horseshoe magnets as now made? Can a permanent magnet be made out of any iron? I do not refer to the residual magnetism remaining in the field magnets of a dynamo when not in motion. A. Any iron or steel which has once been magnetized does not again lose all its magnetism, except by heating it red hot. Its magnetism is then destroyed. Good soft iron, cast or wrought, will, however, retain but little mag-

netism after the magnetizing force is removed. The retentivity to which you allude is the same property in steel as in iron. The field magnets of a dynamo, when of iron, retain little; when of steel, retain more magnetism. A hard steel retains so much that it is called a permanent magnet. It, however, does not retain full magnetic saturation, but loses considerable magnetism very soon after the magnetizing force is removed from it. It is strongest just after it is magnetized. From the above it will be seen that a magnet cannot be made of iron which deserves to be called a permanent magnet.

(10961) M. C. asks: 1. How long an exposure would be necessary to make a lantern slide, by having a negative in contact with a plate in a frame? Exposure by candle or lamp light. A rather fast plate being used, for instance, a framer Banner X. A. The time of exposure for a lantern slide depends upon the density of the negative, the light and other factors being the same, and if you are in doubt draw the slide and expose one-quarter of the plate at a time till the whole is exposed. Then develop and find which part was correctly exposed. A slow lantern slide plate should always be used for the positive for a lantern slide. Such plates are made by all manufacturers. You will have to get the time of exposure by experience. 2. Which in your opinion gives the best negative technically—the tank or time method, the tentative method, or the Watkins factor method? A. Personally we do not like any of the methods of developing you mention. We always use a dark room, and watch the progress of the development. We have no decision to give upon the tank, time, or any other method. With a correct exposure almost any method will produce a good negative; without that, no method can bring forth a fine result.

(10962) J. R. D. asks: If agreeable, will you kindly advise what metal has the most expansive property when subjected to heat, and also state to what extent quicksilver or mercury will expand by heat, and whether or not quicksilver expands more by heat than does water? A. We give you the rates of expansion of several of the metals which expand most rapidly by heating: Potassium 0.000249, sodium 0.000218, mercury 0.000182, indium 0.00014, cadmium 0.000094, lead 0.000088, aluminium 0.000070. Mercury expands more than water does for the same change of temperature near the freezing point. The rate of expansion of water as given in the "Physico-Chemical Tables" of Castell-Evans is 0.0000644. All the figures we have given above are from the same tables, which are of the highest authority.

(10963) T. H. P. asks: Is there any magnetic rod, or anything of the kind in use, for locating gold or silver? If so, where can I get one? A. There is no possible means of locating gold or silver ore by magnetism. Magnetism has no effect whatever on either of these metals, and any claim to locate deposits in the earth by a magnetic rod has no basis.

(10964) P. G. P. asks: Please tell me what is the nature of phosphorus? Can it be kept in a sealed bottle indefinitely? Will it retain its light-giving properties indefinitely? Will heat affect it? A. Phosphorus is one of the elementary substances, just as iron and lead are elements. It does not give light when it has been shut up in a bottle for some time. It can be kept under water anywhere. So long as it is kept away from oxygen it cannot give light or take fire. If the oxygen of the air has access to it, it grows hot and takes fire. Its light is due to the slow combustion of the phosphorus by oxygen, causing it to glow in the dark.

(10965) D. L. asks: 1. Kindly explain through your magazine how, by experimenting with a pendulum, it has been calculated that the gravity force of the earth is 289 times as great as the centrifugal force at the equator. A. The force of gravity at any place is determined from the time required by a pendulum of known length at that place to make one oscillation. The centrifugal force of the earth at the equator is determined from the length of the day, or the velocity of rotation of the earth at tor is 32.0902. Hence if there were no centrifugal force as 0.1112 of the mass of a body at the equator, which makes the body lighter by this amount. The force of gravity at the equator is 32.0902. Hence if there were no centrifugal force, the weight of a body would be the sum of these two, or 32.2014, which is the real mass of the matter of the body. Hence centrifugal force lightens a body 0.1112/32.2014, which equals 1/289 very nearly. You can find all these matters demonstrated in the library of the university of your city. The librarians will assist you to find what you need, or the professor of mechanics or astronomy will advise you. Watson's "Theoretical Astronomy" will contain it. 2. From an infinite or very great distance, in an astronomical sense, our earth will attract a body with an ultimate velocity of 7 miles a second at the moment it would strike the earth. How can I find the corresponding velocity with reference to the sun and the moon? A. You will find the solution of the problem of fall from infinity in Watson as above, or in Young's "General Astronomy," Section 429. We can send you the book for $3.25. 3. If we imagine a tunnel through the earth and through its center (or 8,000 miles long), then letting a body fall into it, what would be the maximum velocity, and at what point in the tunnel would that velocity be attained? A. A body falling through the earth as you describe will have its highest velocity at the center of the earth. The finding of the velocity is a problem of analytical mechanics, to which we refer you. 4. If a bullet sent out from a rifle and in a perpendicular direction will reach a height of one mile, how far would it go at an angle of 30 degrees with the horizontal plane? A. If a bullet will rise a mile in a vertical direction, it will rise to the same distance when rising at an angle of 30 degrees to the horizon. 5. What would be the weight of a cubic foot of water at a depth of 8 miles? A. The compressibility of sea water is 44 millionths per atmosphere at 12 deg. C.; that of pure water at the same temperature is 47 millionths, while at the freezing point it is 50.3 millionths. The temperature would vary considerably as we descend in water. Upon this datum you can calculate the density at a depth of 8 miles. We must say that your questions remind us of an examination paper in college, and we never liked to take examinations.

(10966) G. B. asks: In projecting a lantern slide upon a screen with a single double convex lens the lines on the picture, when viewed close to the screen, within a foot or two, give the colors of the rainbow. If, however, the observer goes back ten or twenty feet more from the screen all this color effect immediately disappears. Will you please explain why this color effect is not equally visible at this distance? I understand, of course, if a chromatic lens is used there will be no such color effect. What I do not understand is why, when you see it so plainly at a foot away, you cannot see it equally plainly at 10 feet, although all the other parts of the picture are equally visible at either distance. A. The lines of a picture are visible to the eye when a line subtends an angle at the eye of about a minute of arc. This is the limiting angle of vision without optical assistance. When one stands one foot from the screen on which is a picture with lines projected by an ordinary convex lens, the lines fill more than this angle. So also do the interference fringes on the edges of the lines. At 20 feet distance from the screen a space twenty times as broad is required to fill the same angle as was filled by a line at one foot distance from the screen. All which is in the wider space is combined in the eye at 20 feet into an image of the same size as was occupied by the line at 1 foot. The color fringes then are combined into white light again, and only the black is seen. If one uses an opera glass at 20 feet the colored fringes are restored and are as visible as at the 20 feet divided by the magnifying power of the glass. If a glass magnified five diameters the lines and fringes appear as when seen at a distance of 4 feet. The restoration of the colors by the opera glass constitutes rather a pretty optical experiment.

(10967) R. D. F. asks: Would you kindly answer these questions? Why will a rainbow form a half-circle at sunset? Why does a rainbow usually show less than a half circle? Why would a bow form a complete circle seen from a balloon? A. A line drawn through the center of the sun and the eye of the observer passes through the center of the rainbow. This line is called the axis of the bow. An angle is formed with this line, the vertex of the angle being at the eye. At an angle of 40 degrees from this line in every direction violet may be seen, and at 42 degrees from this line red may be seen. It should be obvious that all the points which are at the same angle from the axis will lie on the circumference of a circle. The rainbow is for this reason a circular arc. When the sun is on the horizon, the axis will be in the horizon and a half circle is above the horizon whose other half is below the horizon. At sunset then a rainbow will be a half circle. If the sun is high in the heavens, the axis line will go below the surface of the earth before it reaches the horizon, and the part of the rainbow seen will be less than half a circle. If one is upon a mountain top, so that the axis extends far out above the horizon, more than half of the circle of the rainbow will be seen, and from a balloon it is possible to look down upon a cloud and see a circular rainbow, or the whole of the bow. Looking down upon the spray of Niagara Falls, one may see more than half a circle of a rainbow formed by the sun's rays in the gorge below.

(10968) W. W. asks: What is the scientific explanation of the fact that if an egg is held between the hands and compressed along its longitudinal axis, it is almost incapable of being crushed, while a pressure on a transverse axis readily accomplishes a contrary and expected result? A. The ends of an eggshell are domes, and are filled with an incompressible liquid. If these domes are fitted into the soft palms of the hands, and pressure evenly applied to the shell in the direction of its longitudinal axis, it will require considerable force to crush the shell. The liquid contents prevent the shell from collapsing inward; the soft palm prevents it from bursting outward. The part of the shell which is not covered by the hands is very nearly a cylinder, and although it is thin it has considerable strength to resist crushing.

(10969) A. E. S. asks: Kindly advise if an electric doorbell circuit can be formed with the ground and a single wire for a distance of two blocks. Also the formula for the solution of saltpeter used in destroying tree stumps by boring a hole and allowing the fluid to remain all winter and in the spring pouring in kerosene and setting afire. A. An electric circuit can be completed through the earth for any purpose. Make a good ground at each end of the line in water or moist earth, and the bell will ring as well as if a return wire is used. There is no formula needed for using saltpeter on a tree stump. Bore deep holes in the stump, fill them with saltpeter and then with water, and plug the hole. This is done at any time. After six months or longer open the hole, fill it with kerosene oil, and set this on fire. The saltpeter causes the fire to smoulder in the wood.

(10970) R. R. asks: Will you please answer the following question in physics for me? What is the difference, if any, between "mass" and "weight"? For instance, what is the difference between 10 pounds mass and 10 pounds weight; or between 10 kilogrammes mass and 10 kilogrammes weight? A. The mass of a body is determined by the quantity of matter the body contains. Any body has an invariable mass. The weight of a body is not invariable but is affected by the force of gravity at the place of the body. The same mass, 10 pounds of lead, for example, will be the same all over the earth, but it will not weigh the same. It is customary to consider the unit of mass as the weight at a place where the intensity of gravity is unity. At Paris, France, the intensity of gravity is 980.96 cm. The weight of a body at Paris is then 980.96 times its mass. Mass is defined as weight divided by gravity; or weight at any place is its mass multiplied by gravity at that place. Gravity at Washington is 980.10.

(10971) R. R. S. asks: 1. Would a man standing exactly at the North Pole or twenty feet from the Pole be sensible of the earth's rotation from west to east? A. A man at or near the North Pole of the earth would see the stars move in circles, clockwise; sensibly parallel to his horizon without rising and setting. The sun would rise and set once a year, the moon once a month. While above his horizon they, too, would move clockwise around the sky. In this way the earth's rotation on its axis is just as sensible to a man at the Pole as to one at any other point of the earth. 2. Why does the moon rise farther in the north in the winter? And why does it appear nearer the zenith when it is nearest to us? A. The moon rises at the same points of the horizon every lunation. Half of its month it is north of the equator and half of its month it is south of the equator. We only notice the rising of the moon when it is near its full. The full moon is always opposite the sun. In winter the sun is south of the equator, and full moon is north of the equator, in the same part of the sky where the sun is in summer. Hence the full moon runs high in winter. The moon does not appear nearer the zenith when it is nearest the earth. Perigee may be at any phase of the moon since new moon occurs in all points of the orbit in each cycle of the series. 3. How long does it take the sun to make a rotation? A. The time required for a spot to pass from the center of the sun around to the center again is on the average 27.25 days. This is the synodic period of the sun's rotation. The true, or sidereal period, is determined from this to be 27.35 days. Different observers obtain slightly different results, varying from 27.23 days to 27.38 days. The sun's rotation is very peculiar in that the velocity is not the same for different latitudes. This would show that the surface of the sun is not solid, but in a fluid condition. This is discussed in Prof. Young's book on the sun, which we send for $2.

(10972) W. F. J. asks: Why does a charge of electricity (static) pass to the outside surface of a hollow conductor? If the conductor were a solid would the charge pass to its outward surface also? A. A static charge of electricity is on the surface of any conductor, solid or hollow. The reason is the self-repulsion of the parts of the charge for its own parts. Each unit of electricity is as far as it can get from every other unit of electricity. 2. Why is there no lightning in winter? A. There is lightning in winter. We have seen vivid lightning in mid-winter in Massachusetts, lighting the snow to the greatest brilliancy. It is not a common occurrence. 3. Why is the external characteristic of a shunt dynamo a loop? A. The external characteristic curve of a shunt-wound dynamo is a loop because of the fact that all the current goes to the fields when the external circuit is open. The voltage is then the maximu- but there is no current. When the external circuit is closed the external resistance is high and the field coils now begin to receive current, which weakens the voltage. As more and more current passes through the external circuit, less current passes through the field. A point is finally reached where the reduction of external resistance takes so much from the field that the E. M. F. falls more rapidly than before and current begins to decrease also. From this point both current and E. M. F. fall steadily to zero by cutting out resistance. See Sloane's "Handy Book for Electricians," which we send for $3.50.

(10973) M. E. B. asks: The writer would like your advice on the most promising line of engineering that a man might take up, the line with the biggest future. I have been a salesman for the past four years, but don't seem to be able to realize more than two thousand a year in that work, so intend to take up some branch of engineering. I graduated from college as a chemist, but in my experience it is one of the poorest paid of the professions. Having a natural bent toward mechanics, I have been considering taking up structural steel or electrical engineering, but not knowing the line that gives the most promise I would ask what do you suggest, and would it be more profitable to take up a whole department or specialize? A. We are not able to give advice as to the line of work a man should take up, not knowing him personally, excepting to say, take up what you like best. No one can say whether steel construction or electricity work would pay best. It all depends upon the man. If he can push himself into jobs either will pay well. To work on a salary at either in the employ of a company will hardly pay any better than employ by a mercantile company. To make money in either line one must be able to take contracts and get the profits of them. You are the best and only judge of yourself. Decide the line you want to take up and push into it.

(10974) J. A. T. writes: Would you kindly tell me where and how I can obtain any information in regard to placer or hydraulic mining methods? Anything in regard to cost and places where this method is pursued will be appreciated. A. You will find instructive articles on hydraulic placer mining in our SUPPLEMENT Nos. 455 and 1281, and we can also recommend the "Hydraulic Gold Miner's Manual," by T. S. G. Kirkpatrick, $2.25, with which we shall be pleased to supply you. California is the principal scene of hydraulic mining in this country, but the valleys of the Rockies are full of it, where discoveries of placer gold have frequently, if not generally, preceded those of lodes in the hills. It is being superseded in many places by dredging, which facilitates the excavation of gravel from places where hydraulicking is impossible, on account of the difficulty of disposing of tailings. By the latter method gravel may be excavated and washed at a cost so low that gravel carrying gold values of five cents to the ton have been made to pay.

(10975) E. L. says: Does the wheel on the outside rail revolve oftener than the wheel on the inside rail? If not, why not, recognizing that the outside rail is longer than inside rail? A. We would say that the wheels on a steam railroad car or locomotive are rigidly attached to the axle, and therefore have to revolve together at exactly the same rate of speed. The outside rail, however, on a curve, is longer than the inside rail. This makes a certain amount of slippage between the wheels and the rails unavoidable when going around curves. The wheels, however, are somewhat larger in diameter near the flange than they are a few inches away from the flange, and the tendency is for the flange to hug the outer rail of the curves. Therefore, the outer wheel as it is rounding the curve is rolling on a somewhat longer diameter than the inner wheel. This tends to decrease somewhat the amount of slippage there would otherwise be.

(10976) J. H. S. asks: In a great many electrical books and articles on electricity I have noticed the amperage of a certain piece of apparatus is stated, but the voltage is not mentioned at all. How are we to determine the number of watts consumed if the voltage as well as the amperage is not stated? I notice in the "rules and requirements of National Board of Fire Underwriters" they give the carrying capacity of wires in amperes alone. How are we to know whether the capacity they state is for 50 or 220 volts? In field winding we are told so many ampere turns are required per square inch pole face surface for a certain density. How are we to determine the number of turns required if we do not know how many amperes are going to flow over the wire when wound? A. It has been our experience to find both the volts and amperes of a dynamo or motor, or the volts and kilowatts given on the name plate. The carrying capacity of wires is given in amperes because it is amperes which the wires are to carry and not volts. The amperes heat the wires, and not the volts, and the higher the voltage the finer the wire required to carry its current. Hence volts are of no importance to the Fire Underwriters, except to classify the rules for wiring as they do for different voltages. The safety of people from shock depends upon the voltage and not upon the amperes. In the winding of a dynamo the current required to magnetize a field has been determined by the designer, who assumed the amperes and the size of wire to carry them when he determined the size of the magnet cores to give the desired voltage to the machine. Hence the ampere turns are known.

(10977) A. B. wishes to learn more about lunar rainbows. A. Some of the correspondents of our paper who have reported upon lunar rainbows of late seem to be confusing two phenomena which are very unlike and due to entirely different causes—the rainbow and the halo. A rainbow is due to falling rain from a cloud which is on the opposite point of the horizon from the sun or moon at the time. The sun or moon cannot be very high above the horizon and have a long arc of the bow visible, not over 42 deg., at which angle none of the arch would be seen. A rainbow is a half circle at sunrise or

sunset. In a primary bow the red is on the outside of the arch. If two bows are seen, the outer one has the red on the inner side of the arch. If a bow is formed by the moonlight at night, the colors are very faint, and very rarely or never can more than three colors be distinguished—red, yellow, and green. Lunar rainbows are not frequent, and one is fortunate to see one. The writer has seen two in forty years. They are doubtless formed more frequently in one's field of vision, but are so faint as to escape notice. Halos, on the other hand, occur frequently, and are seen without any difficulty in the vicinity of both the sun and the moon. The rings of colored light, seen close to the sun and the moon, or nearer than 10 deg., are called coronæ. The smallest halo has 22 deg. radius, or about half that of the primary bow, but it is a ring with the sun or moon in its center. It surrounds, when seen fully, the sun or the moon. A halo of 46 deg. radius and one of 90 deg. radius are also formed. White circles are also seen, which pass through the sun or moon and are parallel to the horizon. Where these circles cross the circle of the halo, we sometimes see so bright a spot of light that it is called a mock sun, or sun dog. Complicated figures are sometimes formed by the crossing of these circles. The halo of 90 deg. is very rarely formed. The writer has never seen but one. Halos are always at a very great height above the earth's surface, so high that water cannot exist, and the halo is formed by refraction and reflection of the light in crystals of ice. They are signs of a storm, since they indicate the saturation of the upper air, and the lower air will soon be affected. These are not discussed very fully in recent meteorologies. The reader is referred to Loomis's "Meteorology" for much interesting matter upon all these subjects.

(10978) M. D. S. asks: I desire to secure the formula of the solution for making blue prints; how to apply it to the paper, and how to develop and finish it, after printed. Can you inform me of any book treating on the matter and where to procure it? A. To make solution for blue-print paper, make a solution of potassium ferricyanide, 1 ounce to 5 ounces of water; also a second solution of 1 ounce of citrate of iron and ammonia to 5 ounces of water. These two solutions will keep indefinitely in separate bottles. To prepare the paper, take equal parts of each solution and mix them. The mixture is sensitive to light, and the rest of the work must be done in a feeble light. With a swab dipped in the solution cover the paper by passing across in parallel lines, and afterward crosswise of these, so as to have an even layer of liquid all over the paper and yet not enough to flow or drip. The paper is hung by a pin in the dark to dry. It is then ready for printing. After printing in bright sunlight, the picture is developed by putting it under water. Wash thoroughly till the white parts of the picture are clear.

(10979) W. K. asks: 1. What action (chemical) does zinc chloride furnish in a dry cell? Sal-ammoniac? Does manganese furnish any action besides its depolarizing effect? A. The zinc chloride does not exert any chemical action in a dry cell directly; that is, the action of the zinc and ammoniac chloride (sal-ammoniac) is to form zinc chloride. The zinc salts put into a dry cell serve principally to keep the paste porous and moist, since these have a strong affinity for water. Manganese dioxide serves simply as a depolarizer in a dry cell, as it does in a wet cell. 2. Does high initial amperage increase life of a battery, or does it mean that it will be short-lived? A. The amperes of a cell depend upon the external resistance, and there is no propriety in giving amperes, unless it is stated also against what resistance the amperes are flowing. If a large number of amperes are drawn from a cell at first, the cell will be shorter lived than if a low amperage is drawn. A cell will have a certain number of ampere-hours of life. If 100 ampere-hours, the cell will last approximately 100 hours if 1 ampere is the rate of current, but only 10 hours if 10 amperes be drawn. This law is as true of dry as of wet cells. 3. What do you consider best type of wet and dry cells on market to-day for telephone service? A. We have no judgment to give as to the best dry or wet cell. We presume there is no cell which deserves such a distinction. There are many reliable houses offering cells. We presume your local dealers are reliable, and that you are safe in taking their advice. We do not advertise in Notes and Queries. Our advertising columns may be consulted, and we think our advertisers are unusually reliable. We doubt if there is any such thing as a superlatively best thing of any kind. We are not willing to say that there is. 4. In gas and gasoline engines, what affects the life or service of the batteries? A. There is nothing very peculiar in the service a battery performs on a gas engine, except the regularity of its action. It wears out as any other battery does by the work it does, and rather sooner because of the constancy with which it is called upon for current. It is a popular impression that a battery should last indefinitely, but really it is like any other source of power. It can only give back the power which is given to it, and when that is done the battery stops work. No one is ever ready to have the battery stop. Few understand that a battery uses up materials as an engine uses up coal. So much zinc and chemicals, so much electricity. It is a simple matter.

## NEW BOOKS, ETC.

ARTS AND CRAFTS IN THE MIDDLE AGES. A Description of Mediæval Workmanship in Several of the Departments of Applied Art, Together with Some Account of Special Artisans in the Early Renaissance. By Julia De Wolfe Addison. Boston: L. C. Page & Co., 1908. 8vo.; 378 pages. Price, $3.

The very general and keen interest in the revival of arts and crafts in America is a sign full of promise and pleasure to those who are working among the so-called minor arts. In this connection, it is interesting to look into the past, particularly those centuries known as the Middle Ages, in which the handicrafts flourished in special perfection, and to see for ourselves how these crafts were pursued, and exactly what these arts really were. There are very few books dealing with the arts and crafts of the olden time, which are adapted to inform those who have no intention of practising such arts, and yet wish to understand and appreciate the examples which they see in numerous museums or exhibitions, and in traveling abroad. Mrs. Addison's book, consequently, will be welcomed by a large class of readers. "Arts and Crafts in the Middle Ages" is not merely a beautifully illustrated "art book." It is a valuable work, destined to fill a special niche in the library of books which are worth while.

MARINE ENGINEERING. A TEXT BOOK. By Engineer-Commander A. E. Tompkins, Royal Navy. London: Macmillan & Co. New York: The Macmillan Company, 1908. 8vo.; 812 pages. Price, $4.50.

The writer was until recently instructor in steam and marine engineering, marine construction, etc., at the Royal Naval College, Greenwich, England. All those who go down to the sea in ships have a profound respect for those that oversee that mechanical underworld of the great vessels. It is more than surprising to note what a vast amount of detail the marine engineer has under his control. Even to those who are moderately familiar with marine practice, this book will prove a revelation. It is filled with the most valuable material. The illustrations are numerous, well executed and, as far as we can see, they are new. Engines of all sizes and descriptions are dealt with as well as auxiliary engines, such as capstan-engines, blowing engines, and pumps. Great attention is paid to the propeller. The water-tight system is also taken into consideration. Electrical machinery comes in for a fair share of attention. Boiler preservation and repairs, care and adjustment of machinery, the engineer of the watch, are all adequately dwelt upon. The subject of marine steam turbines is very well discussed, and the very latest practice, as the engines of the "Mauretania" are outlined. Internal-combustion engines for boat propulsion are also included. The entire book has been rewritten and revised, and forms a complete text book for the construction and working of steam engines and boilers.

INTERNAL COMBUSTION ENGINES. Their Theory, Construction and Operation. By Rolla C. Carpenter, M.M.E., LL.D., and H. D. Diederichs, M.E. New York: D. Van Nostrand Company, 1908. 8vo.; 597 pages. Price, $5.

This is a very well-made book and the intention of the authors in its preparation has been to present in as simple terms as possible the fundamental and theoretical principles relating to the internal combustion engine, and to describe the various methods of applying these principles to practical construction. The book does not in any way treat of the proportion and strength of the various machine parts. It is largely a compilation from different sources and is, in the main, an outgrowth of a course of lectures on the internal combustion engine delivered to students of Sibley College during the past three years. The thermo-dynamics of the gas engine, the theoretical comparison of various types, combustion, fuels, history of the gas engine, modern types of internal-combustion engines, ignition, mufflers, starting apparatus, estimation of power of the gas engine, methods of testing internal-combustion engines, and performance of gas engines and gas producers, cost of installation and operation all come in for liberal treatment. One of the most peculiar-looking engines in the book is the Sargent complete-expansion engine. It is built as a double-acting tandem. There is but one valve to control admission and exhaust for each end of each cylinder. A single cam performs these various phases while a second cam operates the igniter. The construction is radically different from that used by other designers.

THE MOTORMAN AND HIS DUTIES. By Ludwig Gutmann. Sixth Edition. Revised and enlarged by Lawrence E. Gould. Chicago: The Wilson Company, 1907. 16mo.; 195 pages. Price, $1.50.

The purpose of this book is to familiarize the reader with the operation of an electric car. It tells in simple, terse language, devoid of all technicalities and mathematics many points not generally understood by the average employee who has to do with the operation of a great electric railway rolling stock. Such knowledge cannot fail to make his services more valuable to his company and more satisfactory to himself, and fit him for promotion. The book is intended not only to explain the parts of an electric motor car, but to give some general instruction and advice to those who desire to make the handling of cars their livelihood. It is based on experience gathered during a number of years in the electric railway field, instructing motormen in their duties and work and on results and observations made on operating roads.

MOTOR CAR PRINCIPLES. The Gasoline Automobile. By Roger B. Whitman. New York: D. Appleton & Co., 1908. 12mo.; 318 pages. Price, $1.25 net, postage extra.

As the technical director of the New York School for Automobile Engineers Mr. Whitman is peculiarly well fitted to write a book on the mechanical principles of the motor car. His little volume is primarily intended for the man who is not endowed with overmuch technical knowledge, but who wishes to learn all that he can about his car. For that reason Mr. Whitman has written his treatise in an easy, simple style, which will not strain the mind of a man who is not a trained engineer. The book is divided into thirteen chapters, in which are discussed gasoline engine principles, engine parts, engine balance, 2-cycle engines, carbureting and gasoline feeds, ignition, transmission, running gear, the location of troubles and maintenance and construction.

AMERICAN MACHINIST'S HANDBOOK AND DICTIONARY OF SHOP TERMS. By Fred H. Colvin, A.S.M.E., and Frank A. Stanley. New York: Hill Publishing Company, 1908. 18mo.; 511 pages; full leather limp. Price, $3.

It is with a feeling of confidence that we open this handsome little pocketbook, for the American Machinist has always stood for accuracy and reliable shop methods. The book is filled with good diagrams and tables. We always welcome an accurate pocketbook as it is always certain to cut down trying mental work. This work is very largely devoted to machine shop practice. It is worthy of a good sale.

SMALL HOLDINGS. By F. E. Green. London and New York: John Lane Company. 16mo.; 122 pages. Price, $1 net.

The author has written of conditions which obtain in England, but at the same time it will prove of great interest to those who have small places of say 10 to 25 acres. Full details of receipts and expenditures are given. The book is charmingly illustrated with engravings printed in duotone.

NOTES ON PRACTICAL MECHANICAL DRAWING. By Victor T. Wilson, M.E., and Carlos L. McMaster, B.S. in C.E. East Lansing, Mich.: Published by the authors, 1908. 8vo.; 160 pages.

Of making books on drawing there is no end. The present work contains some unique features, such as machine sketching, which is most admirably treated. The section relating to lettering is also good.

A SHORT HISTORY OF ENGRAVING AND ETCHING. For the Use of Collectors and Students. By A. M. Hurd. Boston: Houghton, Mifflin Company, 1908. 8vo.; 473 pages. Price, $5.

A beautiful book, illustrated by 110 engravings and a frontispiece in photogravure. There is a full bibliography and a classified list and index of engravers. The selection of examples is well made. The extensive classified list of engravers is a monument of patience. Collectors will hail this book with delight.

KRAFT. By Prof. Dr. E. Reyer. Leipzig: Verlag von Wilhelm Engelmann, 1908. 8vo.; 380 pages. Price, $1.50.

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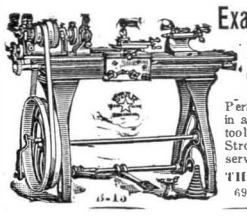

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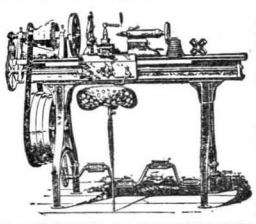

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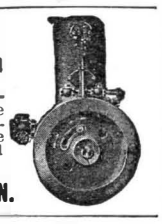

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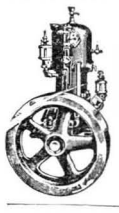

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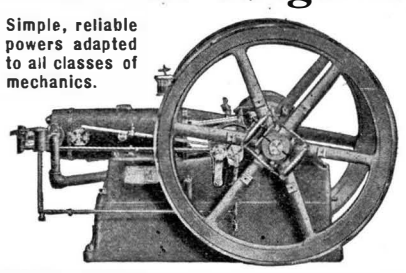

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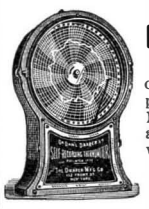

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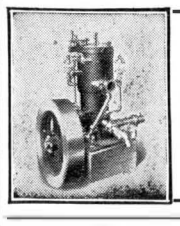

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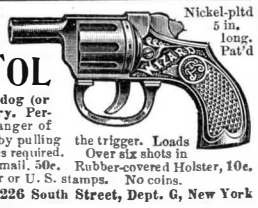

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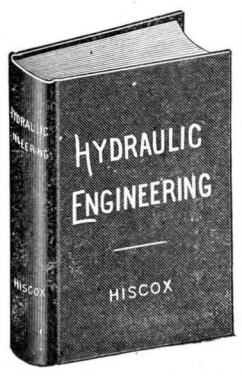


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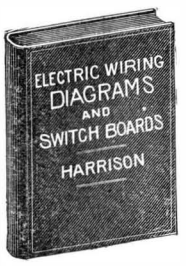


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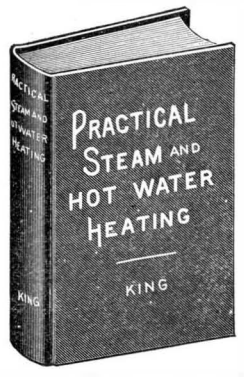


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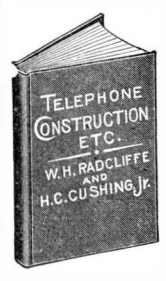


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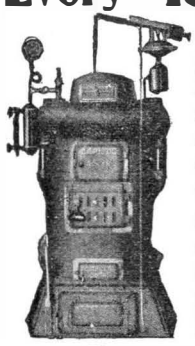

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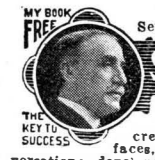

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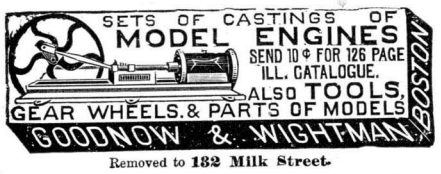

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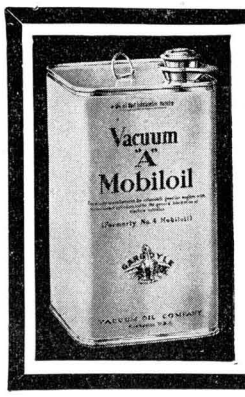


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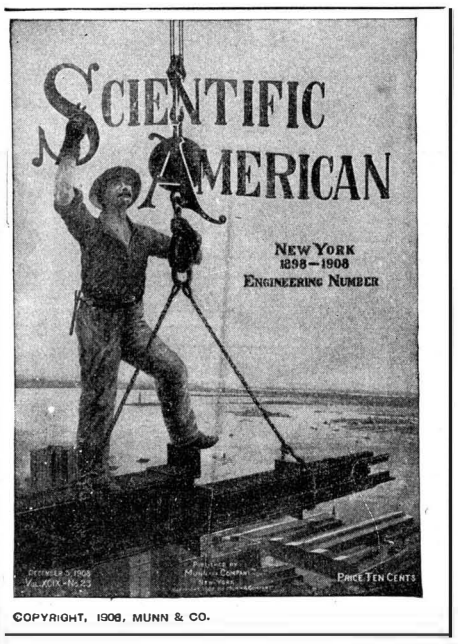

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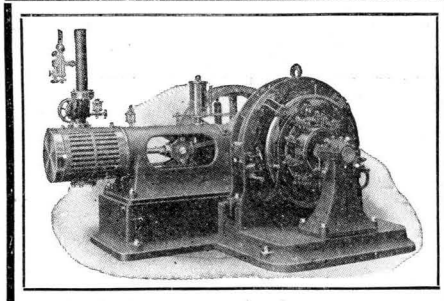

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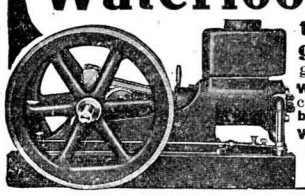

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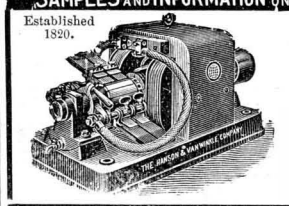

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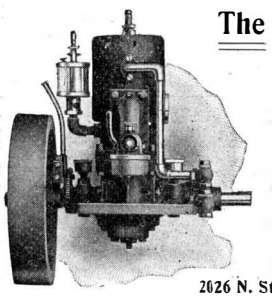

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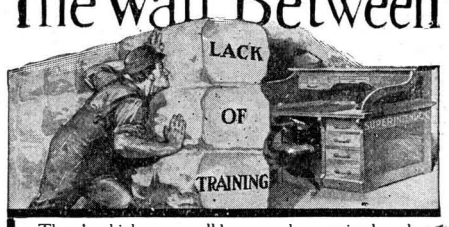


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